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137688

FINAL

REMEDIAL INVESTIGATION REPORT

JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

VOLUME II

JULY, 1985

KUMAR MALHOTRA & ASSOCIATES INC.
ENGINEERS • CONSULTANTS • PLANNERS
Grand Rapids, Michigan/Monroe, Wisconsin

FINAL

REMEDIAL INVESTIGATION REPORT APPENDICES

JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS

PROJECT: S94-3224

JULY, 1985

KUMAR MALHOTRA AND ASSOCIATES, INC.
CONSULTING ENGINEERS
3000 EAST BELTLINE N. E.
GRAND RAPIDS, MICHIIAN 49505
(616) 361-5092

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VOLUME II

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VOLUME II - APPENDICES

APPENDIX A

CHRONOLOGICAL SURVEY

CHRONOLOGICAL SURVEY

The following site chronology is intended to serve as a general summary and order of known activities at or concerning the site. It is a date-by-date compilation of information obtained by reviewing correspondence, reports, and documents pertinent to the site. This information has been extracted from Remedial Action Master Plan prepared by CH2M Hill for this site.

Date:	05/24/73
Key Word:	Site Data
Description:	The Division of Water Pollution Control issued Johns-Manville an operating permit for its closed loop recycle system. This system consisted of a series of settling basins with no surface water dischared to state waters.

Date: 09/00/74

Key Word: Sampling/Testing
Description: The Illinois Institute of Technology Research Institute (IITRI) report, "Characterization and Control of Asbestos Emissions from Open Sources" (Report No. PB-238925), dated September 1974, documents asbestos upwind and downwind of the Johns-Manville site. The field ambient air samples were collected on December 8, 1973. The results were analyzed by both electron microscope and optical microscope methods.

Date: 08/00/75

Key Word: Site Data
Description: The Division of Water Pollution Control, IEPA, Maywood Office, performed an inspection of the Johns-Manville site in August 1975. Mr. Joseph F. Petrilli, Division of Land/Noise Pollution Control, IEPA, found that a permit from the Division of Water Pollution Control was not required because there were no apparent discharges to the state waters.

Date: 10/25/77

Key Word: Site Data
Description: Messrs. Wengrow and Petrilli, Division of Land/Noise Pollution Control, IEPA, performed an inspection of the Johns-Manville site on October 25, 1977. They found that the site was in violation of the IEPA Act and Chapter 7 of the Illinois Pollution Control Board Rules and Regulations on Solid Waste.

Date: 11/09/77

Key Word: Site Data
Description: Mr. Joseph F. Petrilli, Division of Land/Noise Pollution Control, informed Messrs. Mutaw and Wikel, Johns-Manville, that a permit would be required for disposal of a special waste on Johns-Manville property (asbestos and possibly liquid discharges).

Date: 02/23/78

Key Word: Site Data
Description: Ms. Jean I. Larsen, Illinois State Geological Survey, Northeastern Illinois Office, provided Mr. Robert Wengrow, Division of Land/Noise Pollution Control, IEPA, with information concerning the hydrogeologic conditions at the Johns-Manville site.

Date: 06/00/79

Key Word: Site Data
Description: Mr. Scott, Johns-Manville plant manager, indicated at the January 8, 1980, meeting that the Transite pipe operation was discontinued in June 1979.

Date: 01/08/80

Key Word: Site Data
Description: Mr. Sudhir Desai and Ms. Mary Wang Schroeder, IEPA, visited the Johns-Manville site on January 8, 1980. They observed the roofing paper-shingle, particle board, and insulation processes. After observing the processes, Mr. Desai indicated that he believed Johns-Manville was in compliance with the Division of Air Pollution Control regulations. At the meeting, information was discussed concerning plant operation.

Date: 12/09/81

Key Word: Site Data
Description: Mr. Kenneth P. Bechely and Ms. Mary Wang Schroeder, IEPA, visited the Johns-Manville site on December 9, 1981. Mr. Van Dyke, Johns-Manville safety and health coordinator, indicated that the papermill operation has been discontinued. At the meeting, information was discussed concerning the landfilling operation. At this inspection, the site appeared to be in compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPS).

Date: 01/13/82

Key Word: Site Data
Description: Mr. Kenneth P. Bechely, IEPA, indicated to Mr. Donald Gimbel, IEPA, that the Johns-Manville site may be required to obtain a permit for its landfill.

Date: 04/28/82

Key Word: FIT
Description: Ecology and Environment, Inc., performed a field investigation at the Johns-Manville site. They collected airborne asbestos samples at upwind, midsite, and downwind locations. Their conclusion was that the site appears to meet requirements for a positive air emission in the Hazard Ranking System Model.

Date: 05/24/82

Key Word: Sampling/Testing
Description: EMS Laboratories, Inc., data summary sheets for airborne asbestos samples A1613 through A1618, collected on April 28, 1982.

Date: 08/12/82

Key Word: Site Data
Description: Mr. Norm Niedergang, USEPA, calculated the Hazard Ranking System (HRS) score for the Johns-Manville site.

Date: 11/22/82

Key Word: Site Data
Description: Mr. Norm Niedergang, USEPA, and Messrs. Sudhir Desai and Brad Benning, IEPA, visited the Johns-Manville site on November 22, 1982. The purpose of the visit was to observe a potential Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) candidate. Mr. Niedergang discussed the results of the April 28, 1982, Field Investigation Team (FIT) study, and he recommended that a full field investigation be conducted to include both air and bulk soil sampling.

Date: 12/03/82

Key Word: Site Data
Description: Georgi A. Jones, Department of Human Services, informed USEPA Region V that "...due to less than optimum sampling and analytical techniques, the degree of health risk from this site cannot be estimated with any certainty." He suggested collecting additional data and analyzing them by a different method.

Date: 12/30/82

Key Word: Site Data
Description: On December 30, 1982, Johns-Manville was listed on the National Priorities List, 47 Federal Register 58476.

Date: 02/07/83

Key Word: Site Data
Description: USEPA requested additional information from the registered agent for Manville Service Corporation pertaining to their Waukegan, Illinois, facility.

Date: 02/28/83

Key Word: Site Data
Description: Ms. Carolyn A. Lown, Schiff Hardin & Waite, provided Mr. Norm Niedergang, USEPA, with a copy of the comments submitted to USEPA on behalf of Johns-Manville Sales Corporation concerning the proposed National Priorities List, 47 Federal Register 58476 (December 30, 1982).

Date: 04/07/83

Key Word: Site Data
Description: Ms. Carolyn A. Lown, Schiff Hardin & Waite, provided Mr. Basil G. Constantelos, USEPA, with a response to USEPA's letter dated February 7, 1983, requesting information about the waste disposal practices at the Johns-Manville facility in Waukegan, Illinois.

Date: 06/01/83

Key Word: Sampling/Testing
Description: Mr. Kevin Pierard, Weston, Inc. (a contractor for USEPA), conducted an inspection of the disposal site on June 1, 1983. During the inspection, 39 photographs were taken and two water samples were collected. The samples are in storage and no analysis has been conducted.

Date: 06/20/83

Key Word: Sampling/Testing
Description: Johns-Manville submitted an independent review of the air sampling for asbestos conducted on April 28, 1982, by Ecology and Environment, Inc.

Date: 06/21/83

Key Word: Site Data
Description: IEPA conducted a multimedia inspection of the Johns-Manville site on June 21, 1983. Representatives were present from the Division of Land, Water, and Air Pollution Control. Three surface water samples were collected. The samples will be analyzed for heavy metals. Results will be available in mid-August 1983.

Date: 07/13/83

Key Word: Site Data
Description: On July 13, 1983, Mr. Sudhir Desai, IEPA, visited the Johns-Manville site to observe the transport and disposal of asbestos wastes and to determine whether Johns-Manville was in compliance with NESHAPS.

Date: 07/19/83

Key Word: Site Data
Description: Ms. Carolyn A. Lown, Schiff Hardin & Waite, submitted information to Mr. James R. Schneider, CH2M HILL, that updated certain material provided to Mr. Basil G. Constantelos, USEPA, on April 7, 1983.

Date: 10/17/83

Key Word: Ramp
Description: CH2M Hill prepared a Remedial Action Master Plan (Ramp) for the site for USEPA describing existing conditions and recommending remedial investigations and feasibility study.

Date: 4/20/84

Key Word: Water Balance Study
Description: Johns-Manville Service Corporation completed a process water balance study report.

Date: 6/14/84

Key Word: Consent Order
Description: Johns-Manville Sales Corporation and USEPA signed a Consent Order to carry out remedial investigations involving air, soil and groundwater and prepare endangerment assessment and feasibility study. This Consent Order contains details of the scope of the remedial activities along with their scheduled dates of completion.

Date: 7/00/84

Key Word: Work Plan
Description: Work Plan for geotechnical and hydrologeological investigations was submitted to USEPA.

Date: 8/22/84

Key Word: Work Plan (Review Meeting)
Description: Work Plan review meeting was held at site. USEPA and Illinois EPA representatives were present. Preliminary approval of work plan was given to start field investigations.

Date: 9/10/84

Key Word: Site Data (Soil and Groundwater)
Description: Soil and groundwater investigations were started following the approved work plan.

Date: 9/27/84

Key Word: Site Data (Soil and Groundwater)
Description: Soil and groundwater sampling at the site was completed by Kumar Malhotra and Associates (KMA), Inc.

Date:	10/00/84
Key Word:	Revised Work Plan
Description:	Revised work plan incorporating changes due to the review comments was submitted to USEPA.
Date:	10/23/84 to 11/5/84
Key Word:	Site Data (Air)
Description:	Site air sampling was conducted by Ontario Research Foundation.
Date:	1/11/85
Key Word:	Site Data (Executive Summary Review Meeting)
Description:	Preliminary results of soil, groundwater and process water balances were discussed with representatives of USEPA and Illinois EPA. Also discussed was extension of the date of submission of RI report to 3/4/85.
Date:	1/30/85
Key Word:	Site Data (Air)
Description:	Air sampling and analysis report was completed by Ontario Research Foundation.

APPENDIX B

WELL RECORDS OF THE WELLS

IN THE VICINITY OF THE SITE

WELL LOG SUMMARY

(1) P= Public Supply & Human
D= Domestic & Consumption

County Lake State Illinois
Township Benton T 45 N/S, R 12 E
Section No. 9

WELL LOG NO.	OWNERS NAME	OWNERS NO. Permit	WELL TYPE P.O.I.O. (1)	LOCATION	DEPTH FEET	DIA. INCHES	STATIC W.L. FT. B. L.S.	Q GPM	Topo [redacted] Elev	LOG	DRIFT OR ROCK	REMARKS
1	Sanchez	58959	D	SW,NE,SE	218	5	120	9	640	✓	D,R	~~3003~~ Birch, Waukegan

* Limestone Aquifer

[illegible] Public Health
Yellow Copy – Well Contractor
[illegible] Copy – Well Owner

[illegible] ALL PERTINENT INFORMATION REQUESTED AND MAIL ORIGINAL TO STATE DEPARTMENT OF PUBLIC HEALTH, CONSUMER HEALTH PROTECTION, 535 WEST JEFFERSON, SPRINGFIELD, ILLINOIS, 62761. DO NOT DETACH GEOLOGICAL/WATER SURVEYS SECTION. BE SURE TO PROVIDE PROPER WELL LOCATION.

Waukegan, [illegible]

9-1

ILLINOIS DEPARTMENT OF PUBLIC HEALTH
WELL CONSTRUCTION REPORT

1. Type of Well
   a. Dug ____. Bored ____. Hole Diam. 5 in. Depth 218 ft.
   Curb material ____. Buried Slab: Yes ____ No ____
   b. Driven ____. Drive Pipe Diam. ____ in. Depth ____ ft.
   c. Drilled X. Finished in Drift ____. In Rock X.
   Tubular ____. Gravel Packed ____.
   d. Grout:

(KIND)	FROM (Ft.)	TO (Ft.)

2. Distance to Nearest:
   Building ____ Ft. Seepage Tile Field ____
   Cess Pool ____ Sewer (non Cast iron) ____
   Privy ____ Sewer (Cast iron) ____
   Septic Tank ____ Barnyard ____
   Leaching Pit ____ Manure Pile ____
3. Well furnishes water for human consumption? Yes X No ____
4. Date well completed 6/29/77
5. Permanent Pump Installed? Yes X Date ____ No ____
   Manufacturer Red Jacket Type subm. Location ____
   Capacity 10 gpm. Depth of Setting 160 Ft.
6. Well Top Sealed? Yes X No ____ Type ____
7. Pitless Adapter Installed? Yes X No ____
   Manufacturer Williams Model Number ____
   How attached to casing? clamp
8. Well Disinfected? Yes X No ____
9. Pump and Equipment Disinfected? Yes X No ____
10. Pressure Tank Size 42 gal. Type Well-X-Trol
   Location ____
11. Water Sample Submitted? Yes X No ____

REMARKS:

-B2-

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner SANCHEZ CONST. CO. Well No. ~~3003~~ Birch
   Address 3500 Woodlawn, Gurnee, IL.
   Driller HENRY BOYSEN CO. License No. 102-6
11. Permit No. 58959 Date 4/14/77
12. Water from Limestone (Formation) at depth 209 to 218 ft.
13. County Lake
   Sec. 9
   Twp. 45N
   Rge. 12E
   Elev. ____
   SHOW LOCATION IN SECTION PLAT
   SW, NE, SE
14. Screen: Diam. ____ in. Length: ____ ft. Slot ____
15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
5	PVC	grade	197
5	Galv.	197	202

16. Size Hole below casing: 5 in.
17. Static level 121 ft. below casing top which is 1 ft. above ground level. Pumping level ____ ft. when pumping at 8-10 gpm for ____ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Brown Clay	12	12
Blue Clay	87	99
Gravel	2	101
Blue Clay	57	158
Blue Clay-Gravel	51	209
Limestone	9	218

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED [signature] DATE 12/21/77

[illegible] 4.065
1/74 – SWB-1

E-[illegible] -40

WELL LOG SUMMARY

County Lake State Illinois

Township Waukegan T45 N, R12 E

Section No. 10

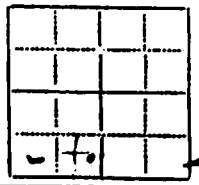
(1) P = Public Supply & Human
O = Domestic & Consumption

WELL LOG NO.	OWNERS NAME	OWNERS NO.	WELL (1) TYPE P.O.I.O.	LOCATION	DEPTH FEET	DIA. INCHES	STATIC W.L. FT. B.L.S.	Q	Topo CHEM Elev	LOG	DRIFT OR ROCK	REMARKS
1	Johns-Manville	1 Co.#1728		SE, SE, SW	108				588	✓	D&R	drilled 1920
2	Johns-Manville	2 Co.#1729		NW, SE, SW	127				588	✓	D&R	drilled 1920
3	Johns-Manville	3 Co.#1730		NW, SE, SW	132				598	✓	D&R	drilled 1920
4	Johns-Manville	4 Co.#1731		SW, SE, SW	132				582	✓	D&R	drilled 1920

* Limestone Aquifer

10-1

TOWN TOWNSHIP Waukegan Map No. 8
COMPANY No. R. 12 E.
FARM Johns-Manville No. 1 T
AUTHORITY Supt.
ELEVATION 588 45 N. Sec. 10
COLLECTOR W.D.G. DATE DRILLED 1920
CONFIDENTIAL

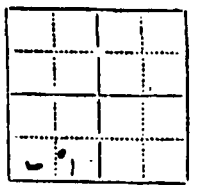


No.	COUNTY NO. 1728 DATA	Thickness Feet	Thickness In.	Depth Feet	Depth In.
	Sand	30.		30	
	Hard pan	25		55	
	Clay, blue	50		105	
	Sand	3		108	
	Rock at 108'				
	NO ENVELOPE				

County LAKE Index No. 0810
T.—DRILL RECORD 10-45N-12E
(30819—8M—7-31) 2 "Illinois Geological Survey, Urbana.

10

TOWN (TOWNSHIP. Waukegan Map No. 8
COMPANY No. R. 12 E.
FARM Johns-Manville No. 2 T
AUTHORITY Supt.
ELEVATION 588 45 N. Sec. 10 NW, SE
COLLECTOR W.D.G. DATE DRILLED 1920
CONFIDENTIAL

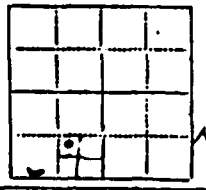


No.	COUNTY NO. 1729 STRATA	Thickness Feet	Thickness In.	Depth Feet	Depth In.
	Sand	34		34	
	Hard pan	21		55	
	Clay, blue	43		98	
	Sand and gravel	14		112	
	Rock	15		127	
	NO ENVELOPE				

County LAKE Index No. 0810
T.—DRILL RECORD 10-45N-12E
(30819—6M—7-31) 2 Illinois Geological Survey, Urbana.

10-3

TOWN TOWNSHIP Waukegan Map No. 8
COMPANY No. R. 12 E.
FARM Johns-Manville No. 5 T
AUTHORITY Supt. Sec.
ELEVATION 588 45 N. 10
COLLECTOR W.D.G. DATE DRILLED 1920
CONFIDENTIAL NW¼SE, S



No.	COUNTY NO. 173 STRATA	Thickness Feet	Thickness In.	Depth Feet	Depth In.
	Sand	30		30	
	Hard pan	25		55	
	Clay, blue	47		102	
	Sand and gravel	13		115	
	Rock	17		132	

NO ENVELOPE

County LAKE Index No. 0810
T.—DRILL RECORD 10-45N-12E
(30819—5M—7-31) Illinois Geological Survey, Urbana.

-86-

10-4

TOWN (NSHIP [illegible] Waukegan Map No. 8

COMPANY No.

FARM Johns-Manville No. 4 T 45 N. R. 12 E.

AUTHORITY Supt. Sec.

ELEVATION 588 10

COLLECTOR W.D.G. DATE DRILLED 1920

CONFIDENTIAL SWSE, SW

No.	COUNTY NO. 1791 STRATA	Thickness Feet	Thickness In.	Depth Feet	Depth In.
	Sand	50		50	
	Hard pan	10		60	
	Clay, blue	37		97	
	Sand and gravel	18		115	
	Rock	17		132	

NO ENVELOPE

County LAKE Index No. 0810

T.—DRILL RECORD 10-45N-12E

(30810—5M—7-31) 3 Illinois Geological Survey, Urbana.

-87

WELL LOG SUMMARY

(1) P= Public Supply & Human
D= Domestic & Consumption

County Lake State Illinois
Township Waukegan T45N/S, R12E/W
Section No. 15

WELL LOG NO.	OWNERS NAME	OWNERS NO.	WELL (1) TYPE P.D.I.O.	LOCATION	DEPTH FEET	DIA. INCHES	STATIC W.L. FT. B. L.S.	Q gpm	Topo Elev.	LOG	DRIFT OR ROCK	REMARKS
1	Griess-Pfleger Tanning Co.			NW¼SW¼NW¼	1670	20x15	79	750	588	✓	R	1900' S & 700' E of NW cor. Quar. Waukegan
2	Griess-Pfleger Tanning Co.			NW¼SW¼SW¼	95	6			585 588			2 wells one 975' N & 260' E of SW cor

* Limestone Aquifer

-88-

City Waukegan County Lake 15

Section 15 BC 1 Twp. No. 45 Range 12 E

Location (in feet from section corner) 1900'S, 700'E, NW Cor.

Owner GRIESS-PFLEGER ~~TANNERY~~ TANNING CO Authority R.J. Gordon, Supt

Contractor S.B. Beiger & Co Address

Date drilled 1929 Elev. above sea level top of well ~~585~~ 586

Depth 1670' Rehabilitated in 1955, new casing, by Beiger

Log 0'-112' to limestone 890' to St. Peter 1150 Dresbach
1540' Mt. Simon Filed with Waukegan 1975-76

Were drill cuttings saved NO Where filed

Size hole If reduced, where and how much

Casing record 550' of 15" 110' of 20"

Distance to water when not pumping 79 Distance to water is 172'

feet after pumping at 750 G. P. M. for hours

Reference point for above measurements

Type of pump B. J. turbine Distance to cylinder 210 ~~180~~' x 10"

Length of cylinder ~~180'~~ 00" 7 Stage Length of suction pipe below cylinder

Length ~~stroke~~ none Speed

Hours used per day Type of power

Rating of motor 125 HP Elec. Rating of pump in G. P. M.

Can following be measured: (1) Static water level NO

(2) Pumping level NO (3) Discharge YES

(4) Influence on other wells NO

Temperature of water Was water sample collected NO

Date Dec 24, 1958 Effect of water on meters, hot water

coils, etc.

Date of Analysis Analysis No.

Recorder Robert T Sarman

3807-22617 12 Date March 9, 1959

15-f

3/5

Town Waukegan Township Waukegan R. 12E

Company F. H. Gray, Jr. Inc. No. T. Sec. 15

Farm Greiss-Pflager Tanning Co.

Authority Sample Study 45 N

Elevation 588

Collector

Confidential Date Drilled 1928

No.	COUNTY NO. 1734 Strata	Thickness Feet	Thickness In.	Depth Feet	Depth In.
	Studied by F. T. Thwaites				
	PLEISTOCENE SYSTEM				
	"Lake sand", no samples	112		112	
	SILURIAN SYSTEM				
	Niagaran series				
	Dolomite, light gray	191		303	
	Shale, red, dolomitic	17		320	
	Dolomite, light gray, water	45		365	
	ORDOVICIAN SYSTEM				
	Cincinnatian series				
	Richmond formation				
	Shale, blue, dolomitic	155		550	
	Mohawkian series				
	Galena-Black River formations				
	Dolomite, light gray, hard	50		600	
	Dolomite, light brownish gray; hole half full of water	50		650	
	Dolomite, blue, gray, and brownish gray, hard	100		750	
	Dolomite, gray, very hard	50		800	
	Dolomite, light bluish gray, hard	40		840	
	Chazyan series				
	St. Peter formation	DO NOT RETURN			
	Sandstone, medium to very fine, light gray, dolomitic; water 840-900'; hole nearly full 900-950'; flow at 950'	160		1000	
	Lower Magnesian				

COUNTY Lake 15-45N-12E

Sample Set #723

(40130—20M) ILLINOIS GEOLOGICAL SURVEY, URBANA (3-41)

SHEET 1 OF 3

SHEET 2 T. 45N R. 12E S. 15
COMPANY F. M. Gray, Jr. Inc. HOLE NO.
FARM Greiss-Pflager Tanning HOLE NO.

No.	Strata	Thickness Feet	Thickness In.	Depth Feet	Depth In.
	"Red rock", no sample, red shale	10		1010	
	Dolomite, gray, hard	30		1040	
	"Red rock", no sample, red shale	10		1050	
	Dolomite, gray, no sample	50		1100	
	Shale, green, no sample	5		1105	
	Dolomite, firm, no sample	45		1150	
	CAMBRIAN SYSTEM				
	St. Croixan series				
	Dresbach formation				
	Sandstone, medium-fine, light gray, dolomitic	15		1165	
	Sandstone, medium, white	90		1255	
	Eau Claire member				
	Sandstone, fine, pink, dolomitic; shale, red	15		1270	
	Shale, green, flow increased	5		1275	
	Sandstone, fine, gray, dolomitic, glauconitic	70		1345	
	Sandstone, very fine, pink, dolomitic, glauconitic, shale	15		1360	
	Sandstone, very fine, gray, very dolomitic, glauconitic	40		1400	
	Sandstone, medium, gray, dolomitic	35		1435	
	Sandstone, fine, light gray, slightly dolomitic	25		1460	
	Sandstone, fine, gray, very dolomitic	15		1475	
	Sandstone, fine, gray, dolomitic; shale, green	10		1485	
	Sandstone, fine, dark gray, very dolomitic, glauconitic	15		1500	
	Sandstone, fine, light gray, dolomitic	35		1535	

COUNTY Lake 15-45N-12E

Sample Set #726

(37251—20M—1-43) ILLINOIS GEOLOGICAL SURVEY, URBANA

15-1

5/5

SHEET 3

T. 45N R. 12E & 13

COMPANY F. M. Gray, Jr. Inc. HOLE NO.

FARM Greiss-Pflager Tanning Co HOLE NO.

No.	Strata	Thickness Feet	Thickness In.	Depth Feet	Depth In.
	Sandstone, fine, gray, very dolomitic	15		1550	
	Sandstone, fine, light gray	15		1565	
	Sandstone, fine, gray, dolomitic; shale, gray	5		1570	
	Sandstone, fine, white, slightly dolomitic	20		1590	
	Sandstone, medium, white, water	10		1600	
	Sandstone, fine, gray, dolomitic	10		1610	
	Sandstone, medium, white, slightly dolomitic	5		1615	
	Sandstone, fine, gray, dolomitic	5		1620	
	Mt. Simon member				
	Sandstone, fine to medium, white, slightly dolomitic	25		1645	
	Sandstone, fine, light gray, slightly dolomitic	5		1650	
	Sandstone, medium, white	20		1670	

COUNTY Lake

Sample Set #726

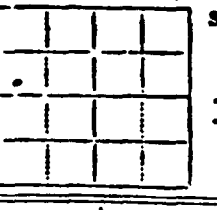
15-45N-12E

(37231—20M—1-43) ILLINOIS GEOLOGICAL SURVEY, URBANA

15-2

TOWN ..WNSHIP Waukegan
COMPANY Ferguson No.
FARM Greiss-Pfleger Tannery T
AUTHORITY
ELEVATION 588 45 N.
COLLECTOR DATE DRILLED 1919
CONFIDENTIAL

Map No. R. 12 E.



No.	COUNTY NO. 1733 DATA	Thickness Feet	Thickness In.	Depth Feet	Depth In.
	A. North well-				
	Drift	95		95	
	Rock at 95'				
	COUNTY NO. 1733				
	B. South well				
	Drift	100		100	
	Rock		6	100	6
	DO NOT RETURN				
	NO ENVELOPE				

312,395-K07

County LAKE Index No. 0815
T-DRILL RECORD 15-45N-12E
(20210—6M—7-31) .2 Illinois Geological Survey, Urbana

SHEET 1 OF 1

15-2

City Indianapolis County Lake

Section 15, 22 Twp. No. 45 N Range 12 E

Location (in feet from section corner) 1600'N, 320'E, SW cor - N well

Owner North Shore Gas Company Authority

Contractor Address

Date drilled Elev. above sea level top of well 585

Depth 95' 2 wells @ 95'

Log drift 0-95' S well: 975' N, 260' E of SW cor

Were drill cuttings saved Where filed

Size hole If reduced, where and how much

Casing record

Distance to water when not pumping Distance to water is

feet after pumping at G. P. M. for hours.

Reference point for above measurements

Type of pump Distance to cylinder

Length of cylinder Length of suction pipe below cylinder

Length stroke Speed

Hours used per day Type of power

Rating of motor Rating of pump in G. P. M.

Can following be measured: (1) Static water level

(2) Pumping level (3) Discharge

(4) Influence on other wells

Temperature of water Was water sample collected

Date Effect of water on meters, hot water

coils, etc.

Date of Analysis Analysis No.

Recorder

2807-22617 12 Date

APPENDIX C

WATER QUALITY DATA

Illinois State Water Survey

WATER RESOURCES BUILDING • MAIL: BOX 232, URBANA, ILLINOIS 61801 • AREA CODE 217
605 E. SPRINGFIELD, CHAMPAIGN PHONE 333-2210

WILLIAM C. ACKERMANN, CHIEF

April 20, 1973

MINERAL ANALYSIS

Sample of water collected March 26, 1973 from a well owned by Old City of Waukegan Lakeshore Site Well in Lake County. Location of well: 2300'E, 1400'N of the SW corner of Section 15-T45N-R12E. Depth of well: 30 feet.

LABORATORY NO. 191547

		mg/l	me/l			mg/l	me/l
Iron (total)	Fe	3.1		Phosphate (filt)	PO_4	0.0	
Strontium	Sr	.61	.01	(unfilt)	PO_4	0.0	
Sodium	Na	117	5.09	Nitrate	NO_3	1.1	.02
Potassium	K	20.6	.53	Chloride	Cl	135	3.81
Barium	Ba	<0.1		Alkalinity	(as $CaCO_3$)	412	8.24
Cadmium	Cd	.00					
Chromium	Cr	3.0	.17				
Copper	Cu	.01					
Lead	Pb	<.05					
Lithium	Li	.06	.01				
Nickel	Ni	<.05					
Zinc	Zn	.07					
Turbidity		23		Hardness	(as $CaCO_3$)	630	12.60
Color		0					
Odor		0		Total Dissolved Minerals		1138	

mg/l = milligrams per liter
me/l = milliequivalents per liter
mg/l x .0583 = grains per gallon

ILLINOIS STATE WATER SURVEY

Laurel M. Henley
Associate Chemist
217-333-0802

LMH/pcb

P
Y

15-1

2/5

August 6, 1932

BOILER WATER ANALYSIS

Sample of water collected July 19, 1932 by Mr. J.W. Harnly of the Greiss Pfleger Tanning Company from a well, tap, located at the north end of Sand Street, Waukegan, Illinois. Depth of well 1670'.

LABORATORY NO. 71336

Determinations made		Pts.per million
Iron	Fe	.4
Manganese	Mn	0.
Silica	SiO_2	8.
Turbidity		0.
Calcium	Ca	170.1
Magnesium	Mg	26.6
Ammonium	NH_4	0.2
Sodium	Na	73.0
Sulfate	SO_4	380.6
Nitrate	NO_3	0.4
Chloride	Cl	38.0
Alkalinity as $CaCO_3$		
Phenolphthalein		0.
Methyl Orange		244.
Residue		898.
Total Hardness		534.

Hypothetical Combinations		Pts.per million	Grs.per gallon
Sodium Nitrate	$NaNO_3$	0.9	.05
Sodium Chloride	NaCl	62.5	3.64
Sodium Sulfate	Na_2SO_4	148.4	8.66
Ammon'm Sulfate	$(NH_4)_2SO_4$	0.7	.04
Magnes'm Sulfate	$MgSO_4$	132.0	7.70
Calcium Sulfate	$CaSO_4$	246.5	14.38
Calcium Carbonate	$CaCO_3$	244.0	14.23
Iron Oxide	Fe_2O_3	0.6	.03
Manganese Oxide	MnO	0.0	.00
Silica	SiO_2	8.0	.47
Total		843.6	49.20

SOFTENING REQUIREMENTS

Lime = 1.84 lbs. per 1,000 gals.
Soda Ash = 2.70 lbs. per 1,000 gals.

STATE WATER SURVEY DIVISION

C.R.Breden,Chemist

CRB/CH/jd

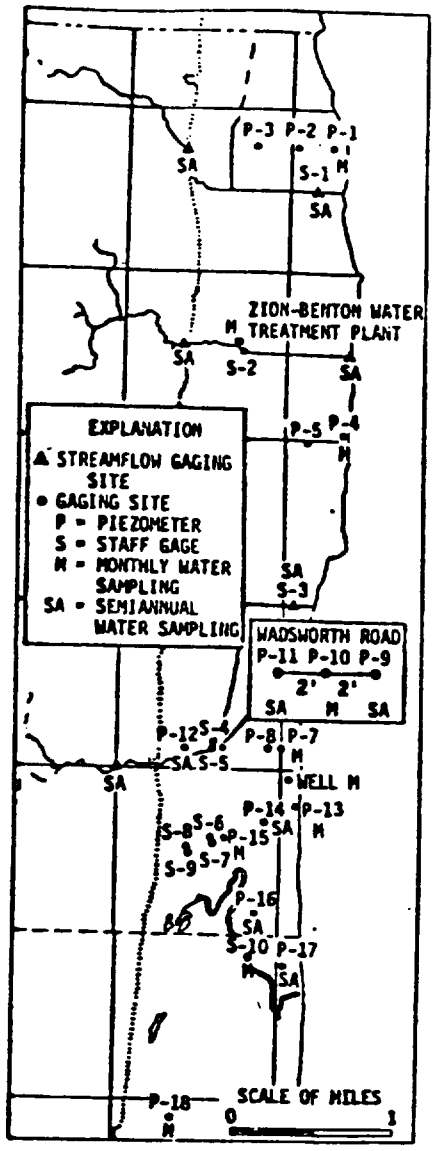


Figure 11. Location of instrumentation for data collection

Monitoring Sites for Groundwater and Surface Water Stages

Groundwater data

Location	*Piezometer*	*Depth (ft)*	*Measuring point elevation (msl)*
LKE 46N12E-			
11.6g	P-1	15	585.85
11.8g	P-2	15	587.55
10.2g	P-3	10	588.31
14.6a	P-4	15	587.96
23.7h	P-5	15	588.06
15.3a	P-6	12	587.86
26.8b	P-7	15	587.05
27.1b	P-8	15	588.28
27.3b	P-9	5	588.37
27.3b	P-10	15	588.09
27.3b	P-11	25	588.11
27.5a	P-12	10	594.20
35.8h	Recorder well	35	594.25
35.8g	P-13	17	587.58
34.1f	P-14	15	586.74
34.3e	P-15	12	586.36
34.2b	P-16	15	589.60
LKE 45N12E-			
2.8g	P-17	15	589.95
10.6h	P-18	15	588.30

Surface water data

Location	*Staff gage*	*Reference point elevation* (msl)*
LKE 46N12E-		
11.7d	S-1	585.00
15.3e	S-2	587.41
26.8h	S-3	585.50
27.4b	S-4	588.79
27.4b	S-5	589.15
34.4e	S-6	586.02
34.4e	S-7	585.92
34.5e	S-8	585.87
34.5e	S-9	586.38
LKE 45N12E-		
3.2h	S-10	586.43

*Reference point is 3.00-inch mark on gages and point of red arrow at S-2

NOTE: All data were recorded weekly with the exception of the recorder well which was measured continuously.

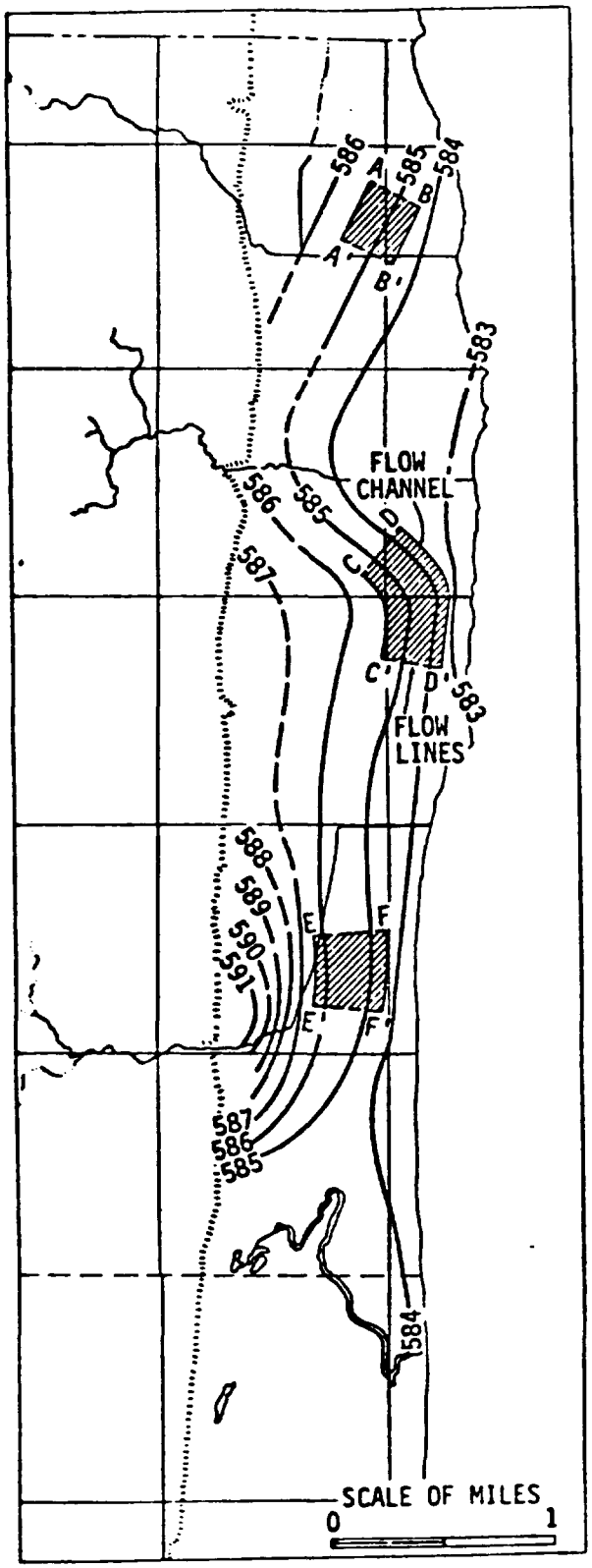
Range of Water-Level Fluctuations at Monitoring Sites

Piezometer	Land surface datum	Low: Depth below surface (ft)	Low: msl	Low: Date	High: Depth below surface (ft)	High: msl	High: Date	Fluctuation (ft)
P-1	585.10	3.64	581.46	2/4/76	1.43	583.67	4/9/75	2.21
P-2	587.10	5.03	582.07	10/8/75	1.64	585.46	4/30/75	3.39
P-3	387.91	5.43	582.48	10/8/75	1.86	586.05	3/10/76	3.57
P-4	587.51	6.51	581.00	1/28/76	4.75	582.76	6/25/75	1.76
P-5	587.41	5.00	582.41	10/8/75	2.34	585.07	4/30/75	2.66
P-6	587.11	2.63	584.48	10/8/75	0.20	586.91	3/19/75	2.43
P-7	586.60	4.49	582.11	2/4/76	2.30	584.30	6/18/75	2.19
P-8	587.08	4.32	582.76	10/22/75	2.02	585.06	3/10/76	2.30
P-9	587.52	3.65	583.87	8/12/75	0.81	586.71	1/10/75	2.84
P-10	587.49	3.65	583.84	8/12/75	0.88	586.61	3/4/76	2.77
P-11	587.16	3.32	583.84	8/12/75	0.55	586.61	3/4/76	2.77
P-12	593.80	6.12	587.68	10/8/75	2.38	591.42	2/26/75	3.74
P-13	587.12	6.06	581.06	1/28/76 2/4/76	4.01	583.11	4/9/75	2.05
P-14	585.84	3.73	582.11	10/8/75	1.45	584.39	3/12/75 3/19/75	2.28
P-15	584.86	2.81	582.05	8/12/75	0.80	585.66	3/19/75	3.61
P-16	589.10	6.80	532.30	10/8/75 10/22/75	3.82	585.28	3/19/75	2.98
P-17	589.45	7.30	582.15	11/5/75	4.34	585.11	3/19/75	2.96
P-18	587.40	5.29	582.11	10/8/75	2.22	585.18	3/19/75	3.07
Recorder well	592.50	11.01	581.49	2/4/76	8.94	583.56	4/4/75	2.07

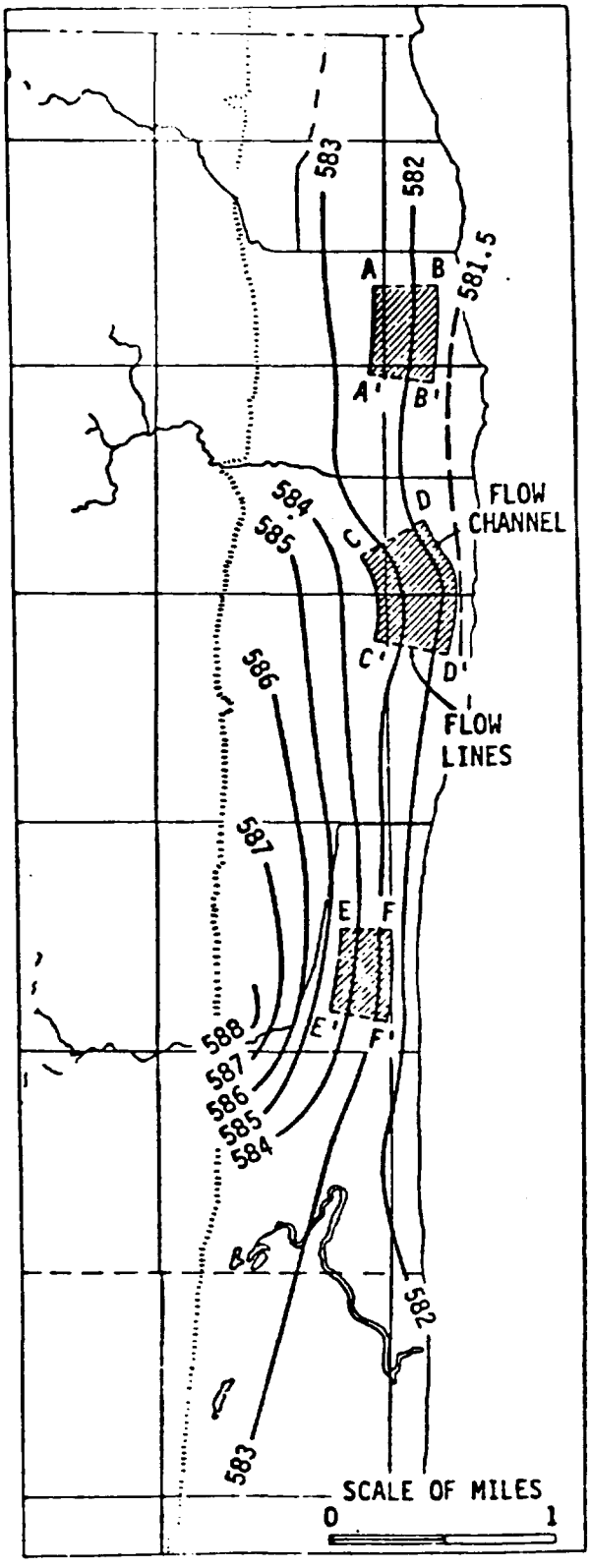
Table 3. Observed Maximum and Minimum Surface Water Stages

Staff gage	Maximum: msl	Maximum: Date	Minimum: msl	Minimum: Date	Fluctuation (ft)
S-1	584.01	2/26/75	Dry	Sep-Oct 1975	
S-2	585.96	6/25/76	582.25	12/17/75	3.71
S-3	584.56	3/4/76	582.18	10/29/75	2.38
S-4	587.77	2/19/75	Dry	Jun 1975-Jan 1976	
S-5	587.20	3/4/76	Dry	Jun 1975-Jan 1976	
S-6	585.68	2/26/75	Dry	Jul-Nov 1975	
S-7	585.68	2/26/75	Dry	Jul-Nov 1975	
S-8	585.65	2/26/75	Dry	Aug-Oct 1975	
S-9	585.66	2/26/75	Dry	Aug-Oct 1975	
S-10	585.68	3/19/75	580.4*	Feb-Mar 1976	5.3*

*Estimated



Water table configuration, April 9, 1975



Water table configuration, November 5, 1975

Monthly Analyses of Water Samples

(Chemical constituents in milligrams per liter)

	Fe	Ca	Mg	Na	K	NO_3	Cl	SO_4	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)	Total dissolved minerals	Temperature (°F)
January 1975												
P-1	4.2					0.9	21	63.6	384	404	515	47
P-3	1.6					1.1	6	83.7	190	248	328	44.5
P-4	4.6					0.7	47	1.6	290	280	379	48
P-7	5.0					0.5	400	59.9	352	595	1076	46.5
P-8	2.2					0.5	170	66.0	304	200	691	44.5
P-9	17					0.6	50	133.5	268	334	532	39
P-10	2.8					0.5	160	99.4	250	340	680	42.5
P-11	1.5					0.8	49	129.6	162	274	423	40.5
P-12	4.3					0.6	92	35.4	460	496	649	43
P-13	7.3					0.4	125	38.3	244	340	484	49
P-14	1.8					0.3	56	33.7	294	258	440	44
P-16	1.6					0.5	3	17.1	244	250	282	46.5
P-17	0.1					0.6	6	33.5	214	252	281	46
P-18	6.7	74.8	26.9	23.9	4.6	1.8	28	1.2	336	298	408	42.5
Well	4.9	86.4	33.7	19.6	1.8	1.4	35	23.9	334	354	446	48
Lake Michigan Tributary												
Bluff	1.3	78.4	36.1	26.0	1.8	19.3	43	97.3	230	344	478	32
S-1	7.2	84.4	32.5	6.2	1.8	1.6	3	82.1	274	344	412	
Kellogg Ravine												
Bluff	0.7	87.2	35.1	35.2	2.7	26.7	65	106.6	224	362	532	32
Beach	1.2	83.2	34.2	35.1	2.0	22.4	64	83.1	232	348	514	34.5
Bull Creek												
Bluff	0.4	93.6	43.9	91.3	2.5	2.7	133	139.7	280	414	688	
S-3	2.9	98.4	36.1	36.8	4.3	2.0	59	66.6	328	394	547	35
S-10	0.6	54.4	34.2	25.2	3.6	1.2	33	46.7	240	276	373	
Lake	0.5	37.2	10.9	5.6	1.2	1.5	8	23.9	104	138	164	34
February 1975												
P-1	5.2					0.5	20	59.0	388	408	523	46
P-4	5.2					0.7	60	2.9	284	282	404	47
P-7	5.7					0.5	410	53.3	348	526	1058	43
P-10	1.6					0.4	59	88.7	236	272	458	40
P-13	9.4					0.5	150	34.8	226	344	499	49
P-18	9.3					1.1	50	7.6	420	376	521	43
Well	2.2					0.5	29	29.8	332	350	433	
S-10	0.5	80.0	34.7	39.3	4.7	6.2	60	108.4	224	342	491	32
Lake	0.3	38.4	11.2	6.7	1.6	1.5	10	25.1	108	142	175	46
March 1975												
P-1	11	102	40.0	14.7	2.7	0.5	20	58.8	388	420	499	49
P-4	7	67.2	21.0	47.0	8.4	0.6	66	9.1	272	254	395	49
P-6	2.3	66.4	23.0	48.0	3.2	1.1	92	3.1	244	260	415	45
P-7	4.6	110	47.3	170.0	4.6	0.4	330	61.7	336	470	949	45
P-10	0.2	68.8	36.6	30.3	2.1	0.0	54	85.4	242	322	474	43
P-13	7.5	92.8	36.1	72.6	4.8	0.4	180	39.3	244	380	604	49
P-15	0.4	44.0	26.8	21.2	2.1	0.3	25	16.0	220	220	301	45
P-18	15	133	43.9	43.5	5	1.7	80	191.9	308	512	729	49
Well	0.4	85.6	37.6	13.1	1.5	0.6	28	40.7	324	368	445	50
S-10	0.9	27.2	11.2	21.9	2.7	1.1	34	34.8	78	114	196	46
Lake	0.4	37.6	11.7	7.3	1.3	1.4	13	22.4	114	142	166	53

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(Continued)

(Chemical constituents in milligrams per liter)

	Fe	Ca	Mg	Na	K	NO_3	Cl	SO_4	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)	Total dissolved minerals	Temperature (°F)
April 1975												
P-1	1.5	104.0	41.5	15.4	2.7	0.6	19	54.3	384	430	508	53
P-4	4.8	73.6	26.4	53.6	9.2	0.6	79	30.9	276	292	473	50
P-6	2.3	56.8	18.6	44.7	2.8	1.0	45	1.0	250	218	354	49
P-7	1.4	94.4	45.8	168	3.9	0.1	280	52.5	336	424	898	52
P-10	0.5	71.2	35.6	37.8	1.9	0.1	51	76.1	260	324	463	52
P-13	14	78.4	32.2	74.7	4.5	1.1	146	38.7	256	328	550	53
P-15	2.6	48.8	26.8	22.8	2.0	0.5	25	14.4	230	232	312	52
P-18	14	99.2	35.1	39.1	3.8	1.8	53	99.8	300	392	542	47
Well	0.3	92.8	37.1	13.0	1.6	0.3	29	47.1	328	384	463	54
S-10	1.4	69.6	30.8	26.8	2.4	1.4	42	81.7	202	300	416	56
Lake	0.3	37.6	11.2	6.5	1.3	1.3	11	23.2	114	140	160	48
May 1975												
P-1	1.4	99.2	42.4	16.2	2.9	0.5	19	47.5	384	422	492	54
P-4	7.1	81.6	26.4	65.0	10.8	0.7	98	57.4	268	312	539	52
P-6	2.6	61.6	21.0	40.3	3.2	1.1	52	7.6	244	240	373	57
P-7	2.3	86.4	42.4	147	3.6	0.2	235	48.5	338	390	812	56
P-10	0.2	64.0	41.5	39.3	1.6	0.5	61	78.6	254	330	456	53
P-13	9.8	78.4	33.7	74.2	3.9	0.2	138	39.1	266	334	569	54
P-15	5.7	70.4	25.9	23.4	1.8	0.5	25	8.0	296	282	365	54
P-18	9.2	80.0	29.3	31.2	3.6	0.8	44	72.2	254	320	448	52
Well	0.4	91.2	39.0	13.2	1.4	0.3	34	45.3	332	388	462	54
S-10	0.8	72.0	34.2	25.0	2.1	2.5	40	55.1	266	320	424	73
Lake	0.1	36.0	10.7	5.4	1.2	0.9	10	22.6	112	134	166	46
June 1975												
P-1	1.1	92.8	42.9	16.6	2.7	0.3	19	40.7	378	408	453	61
P-4	3.5	76.8	24.4	58.2	8.6	0.2	82	46.9	264	292	491	58
P-6	0.6	46.4	16.1	28.0	2.9	0.6	72	11.1	154	182	305	65
P-7	1.6	76.0	37.1	124	3.5	0.2	165	40.1	372	342	684	60
P-10	0.2	66.4	34.2	55.0	1.7	0.2	79	95.9	214	306	494	64
P-13	2.6	73.6	31.3	72.5	4.0	0.1	115	37.2	264	312	509	61
P-15	4.0	69.6	24.4	22.4	2.5	0.4	23	17.3	270	274	336	63
P-18	6.5	73.6	25.4	28.4	3.2	0.6	35	42.6	258	288	389	56
Well	0.7	91.2	37.6	14.7	1.6	0.2	34	45.0	320	382	430	60
S-10	0.7	64.0	29.8	38.6	2.8	0.7	36	66.9	242	282	406	78
Lake	0.0	34.8	11.4	4.7	1.1	1.9	9	23.7	106	134	148	50
July 1975												
P-1	5.0	83.2	45.4	17.8	2.8	0.5	18	34.4	368	394	445	64
P-3	2.2	81.6	30.3	8.4	2.0	0.6	16	102.4	212	328	401	67
P-4	2.5	73.6	27.8	66.5	12.0	0.4	91	51.0	268	298	514	66
P-6	0.9	51.2	20.6	48.2	3.0	0.5	83	17.3	180	212	361	68
P-7	1.3	64.0	30.3	83.0	3.1	0.5	105	26.5	296	284	518	66
P-8	1.5	76.8	27.8	206	4.9	0.3	285	70.8	298	306	891	67
P-9	13	81.6	27.4	68.9	2.4	0.2	43	85.8	324	316	541	69
P-10	0.3	49.6	35.0	61.6	1.9	0.5	85	101.0	196	268	472	66
P-11	0.3	32.8	43.3	48.2	3.0	0.4	54	94.4	192	260	424	70
P-12	2.9	91.5	43.7	49.8	2.5	0.7	115	47.9	324	408	567	67
P-13	0.8	58.4	32.2	67.4	4.1	0.3	100	26.1	256	278	472	65
P-14	1.0	54.4	24.0	38.4	2.3	0.4	13	24.1	274	234	328	68

(Continued on next page)

(Continued)

(Chemical constituents in milligrams per liter)

	Fe	Ca	Mg	Na	K	NO_3	Cl	SO_4	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)	Total dissolved minerals	Temperature (°F)
P-15	2.7	65.6	26.9	22.4	2.5	0.7	23	26.5	268	274	356	67
P-16	1.5	56.0	23.0	1.5	0.9	0.3	0	15.6	220	234	247	62
P-17	0.2	18.4	26.8	1.4	0.6	0.0	2	24.9	126	152	161	63
P-18	1.9	54.8	19.8	25.8	3.1	0.8	27	21.8	212	218	304	64
Well	5.7	88.0	35.6	17.7	1.6	0.6	36	30.0	340	366	446	61
Lake Michigan Tributary												
Bluff	2.1	70.4	33.2	16.4	2.6	1.9	19	74.7	238	312	394	73
S-1	2.4	53.6	31.7	8.6	1.9	2.0	3	22.2	244	264	292	83
Kellogg Ravine												
Bluff	3.4	48.0	20.4	16.3	3.6	1.2	23	24.7	180	204	277	78
Beach	3.6	63.2	26.9	19.9	2.8	0.7	31	45.7	220	268	352	81
Bull Creek												
Bluff	1.8	86.4	38.1	28.8	4.3	0.7	41	48.5	320	372	472	77
S-3	1.2	76.8	40.0	30.5	18.3	1.7	36	20.6	394	356	475	77
S-10	0.4	45.6	28.7	20.0	1.3	1.5	25	34.4	200	232	313	82
Lake	0.3	36.0	11.2	5.3	1.3	2.0	9	24.1	110	136	160	64
August 1975												
P-1	0.9	75.2	42.4	18.3	3.0	0.5	17	31.7	344	362	421	67
P-4	2.4	73.6	25.4	69.5	13.2	0.8	92	52.2	256	288	498	61.5
P-6	0.5	40.8	23.8	76.6	4.4	0.8	96	18.3	202	200	397	69
P-7	0.4	52.8	31.1	83.5	3.2	0.6	120	19.3	260	260	493	66.5
P-10	0.2	43.2	34.2	57.1	1.6	0.8	76	88.9	176	248	425	69
P-13	0.2	36.8	34.0	67.2	4.4	0.6	98	15.6	236	232	429	69
P-15	3.7	78.4	33.2	23.2	2.4	0.9	22	32.9	320	332	419	69
P-18	4.5	60.0	23.0	23.2	2.8	1.3	40	9.1	232	244	321	68
Well	2.0	80.8	37.6	16.2	1.6	0.8	35	34.4	316	356	430	65
S-10	1.0	40.0	25.3	15.8	0.8	1.4	24	30.6	188	204	288	77.5
Lake	0.3	36.0	10.2	4.8	1.0	1.2	8	21.4	100	132	153	61
September 1975												
P-1	0.9	68.8	46.8	17.2	3.3	1.2	18	35.8	348	364	424	64
P-4	2.3	66.4	27.8	65.6	13.7	1.1	91	51.6	264	280	499	62
P-6	0.5	25.8	42.4	77.1	3.8	1.4	100	19.1	224	212	427	
P-7	0.5	48.0	33.1	88.0	3.7	1.0	138	25.1	236	256	491	64
P-10	0.2	40.8	34.5	52.2	1.9	0.8	70	95.4	168	244	417	66
P-13	0.2	36.0	32.6	72.0	5.0	0.4	92	20.6	228	224	411	67
P-15	3.7	72.8	31.7	21.3	2.4	0.8	18	42.6	296	312	391	67
P-18	8.8	76.8	26.4	26.9	3.0	1.6	40	3.1	300	300	396	62
Well	0.2	72.0	35.1	17.3	0.6	0.4	34	38.3	284	324	399	65
S-10	0.2	40.0	24.3	16.8	1.2	1.6	20	31.7	168	200	258	63
Lake	0.3	35.2	11.7	6.4	1.3	2.1	9	24.1	112	136	173	52
October 1975												
P-1	0.8	78.4	42.0	17.2	3.3	0.4	16	38.1	348	368	424	62
P-4	2.7	66.4	28.7	65.1	14.5	0.8	88	53.1	256	284	509	59
P-6	0.6	49.2	27.0	78.9	3.6	0.9	102	14.6	250	234	453	63
P-7	0.5	50.4	33.6	96.3	3.8	0.3	177	23.7	218	264	560	64
P-10	Tr.	39.2	35.5	48.3	1.6	0.2	65	92.8	168	244	413	63
P-13	0.2	38.0	23.8	70.6	5.2	0.3	102	24.3	236	234	434	66
P-15	0.5	52.4	31.9	21.5	2.4	0.5	19	21.8	272	262	343	65
P-18	11	86.4	30.2	28.4	3.1	1.2	40	4.1	356	340	456	62

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(Continued)

(Chemical constituents in milligrams per liter)

	Fe	Ca	Mg	Na	K	NO_3	Cl	SO_4	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)	Total dissolved minerals	Temperature (°F)
Well	1.8	76.4	34.8	18.3	1.3	0.4	39	19.1	312	334	412	62
S-10	0.2	38.4	27.2	14.9	1.1	0.5	24	36	176	208	274	60
Lake	0.1	34.4	11.2	6.2	1.4	1.6	9	22.8	112	132	157	56
November 1975												
P-1	0.2	69.6	44.4	16.2	3.3	0.6	16	43.6	324	356	395	51
P-4	3.1	74.4	27.4	65.1	13.6	0.8	92	54.1	264	298	492	52
P-6	2.5	62.8	26.1	72.0	2.9	1.5	104	2.7	270	264	442	49
P-7	0.7	53.6	35.1	107	4.2	0.3	200	24.1	202	278	574	54
P-10	0.2	43.2	36.0	47.5	1.9	0.4	64	94.0	166	256	394	53
P-13	0.4	44.0	30.6	71.2	4.9	0.6	94	26.5	226	236	418	52
P-15	1.4	40.8	34.5	25.1	2.8	0.7	17	20.4	254	244	316	52
P-18	9.2	90.4	31.7	28.2	3.5	1.7	36	1.0	372	356	445	52
Well	0.1	66.0	34.9	19.2	1.8	0.9	33	18.1	284	308	357	52
S-10	0.2	48.8	33.6	23.8	2.7	1.0	33	59.9	200	260	345	34
Lake	0.9	37.6	10.7	6.5	1.2	2.5	10	20.4	110	138	180	44
December 1975												
P-1	0.3	68.0	44.4	16.4	2.9	0.4	18	56.0	318	352	428	50
P-4	2.1	77.6	29.3	62.8	12.7	0.3	98	62.3	272	314	536	50
P-6	4.3	60.0	24.9	72.5	2.2	0.9	100	3.5	278	252	468	45
P-7	0.6	72.8	31.7	128	3.9	0.2	220	26.9	274	312	685	50
P-10	1.0	61.6	36.6	49.1	1.8	0.3	73	96.1	228	304	485	46
P-13	0.1	57.2	29.4	58.3	4.5	0.5	84	28.2	252	264	419	51
P-15	2.4	52.8	37.6	24.5	2.4	0.6	19	43.0	276	286	352	54
P-18	12	91.2	30.0	28.4	3.0	1.6	36	0.0	384	351	445	49
Well	1.4	74.4	31.7	18.3	1.5	0.5	23	9.1	326	316	367	52
S-10	1.7	59.2	29.8	33.6	3.2	3.3	54	87.2	182	270	392	33
Lake	0.5	38.8	10.5	5.8	1.6	6.3	11	25.3	112	140	204	50
January 1976												
P-1	2.0	69.6	44.4	28.1	2.9	0.5	36	54.3	318	356	453	44
P-4	2.2	76.0	30.3	65.6	11.1	0.6	92	47.3	300	314	534	47
P-6	3.9	62.4	25.9	73.3	2.4	1.5	94	2.9	286	262	466	40
P-7	2.0	56.0	25.4	99.3	3.4	0.4	122	20.1	280	244	511	45
P-10	0.8	72.8	46.3	102	2.1	0.4	205	88.9	232	372	674	44
P-13	1.1	54.8	24.2	55.8	3.6	0.4	75	26.1	230	236	389	49
P-15	3.9	49.2	35.3	26.8	2.3	0.7	19	29.2	272	268	346	44
P-18	12	92.0	32.7	28.4	2.8	1.6	36	1.6	382	364	466	43
Well	0.4	76.0	33.2	14.5	1.4	0.5	17	21.2	316	326	374	47
Lake	0.2	37.6	11.2	6.8	1.2	2.0	10	22.4	116	140	166	39
February 1976												
P-1	2.7	67.2	44.9	17.1	3.3	0.5	17	57.2	314	352	423	41
P-4	2.0	74.4	30.8	69.1	10.7	0.8	98	41.6	290	312	523	48
P-6	4.2	62.4	25.4	72.3	2.8	1.6	96	1.6	276	260	462	44
P-7	0.5	44.0	20.4	86.6	3.7	1.2	76	14.6	260	194	437	46
P-10	1.2	78.4	45.8	116	3.0	0.6	205	98.7	252	384	723	43
P-13	1.2	55.2	23.0	60.8	4.0	1.6	78	27.6	228	232	408	48
P-15	1.9	47.6	39.2	28.3	2.8	1.0	21	39.5	272	280	368	45
P-18	11	92.0	32.7	29.3	3.4	1.2	37	1.2	380	364	475	46
Well	1.8	78.4	34.7	11.1	1.5	0.4	17	32.5	312	338	382	50

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(Concluded)

(Chemical constituents in milligrams per liter)

	Fe	Ca	Mg	Na	K	NO_3	Cl	SO_4	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)	Total dissolved minerals	Temperature (°F)
Bull Creek												
Bluff	2.1	63.2	28.8	52.6	2.7	15.3	93	92.8	166	276	469	41
S-3	1.7	56.8	22.0	26.8	3.5	3.9	43	34.4	192	232	349	36
S-10	0.6	54.4	25.4	53.8	3.4	5.7	84	74.1	158	240	403	38
Lake	0.3	38.8	12.4	6.6	1.4	2.0	10	23.4	124	148	165	42
March 1976												
P-1	2.1	68.0	44.4	19.3	3.3	0.6	18	60.7	310	352	441	52
P-4	3.5	73.6	29.3	67.7	9.1	0.6	102	31.9	288	304	521	51
P-6	2.1	36.0	15.1	109	2.9	1.6	85	1.6	272	152	440	48
P-7	1.7	54.0	22.3	77.7	4.0	0.4	88	17.9	260	226	435	54
P-10	2.6	70.8	31.5	65.0	2.0	0.6	100	128.2	184	306	537	50
P-13	0.3	47.6	23.6	59.4	3.9	0.4	81	25.1	212	216	387	50
P-15	2.1	54.0	38.3	26.6	2.7	0.8	22	48.5	272	292	380	53
P-18	13	97.6	34.2	28.8	3.0	1.1	41	13.4	384	384	480	49
Well	1.5	82.4	34.2	10.7	1.4	0.5	32	33.3	298	346	416	51
Bull Creek												
Bluff	1.4	81.2	38.3	33.1	2.0	4.3	52	126.7	232	360	507	52
S-3	1.3	82.0	33.3	43.4	7.5	7.8	71	53.3	278	342	494	49
S-10	0.9	74.0	34.4	32.7	2.6	1.5	52	102.0	222	326	465	53
Lake	0.3	36.0	10.8	6.7	1.3	2.3	10	23.9	114	134	166	49
April 1976												
P-1	2.9	67.6	44.6	16.1	3.2	1.3	17	55.5	310	352	421	51
P-4	4.1	79.6	29.5	71.4	8.8	1.1	112	25.1	310	320	535	48
P-6	3.1	52.8	21.5	76.1	2.8	1.3	94	2.3	268	220	443	50
P-7	1.2	52.0	24.0	76.9	3.8	0.7	88	16.3	262	228	432	49
P-10	1.9	56.8	25.4	38.8	2.5	0.4	48	88.5	176	246	387	48
P-13	0.4	44.8	23.8	58.7	3.9	0.0	80	21.6	210	210	369	50
P-15	5.0	63.2	44.9	26.1	2.7	1.1	23	66.9	306	342	443	51
P-18	14	103.2	38.1	28.6	3.1	1.4	39	8.8	416	414	505	49
Well	3.1	81.6	34.7	12.0	1.6	0.4	33	30.4	296	346	408	49
Bull Creek												
Bluff	7.7	84.4	39.3	31.2	1.9	6.0	47	115	250	372	503	51
S-3	1.2	80.8	34.2	43.1	6.9	7.1	71	51.8	282	342	483	56
S-10	0.6	67.2	30.8	28.4	2.7	2.1	43	88.4	202	294	401	56
Lake	0.6	39.2	11.2	9.2	1.5	3.8	13	28.0	120	144	189	46

APPENDIX D

ESTIMATED SOLID WASTE QUANTITIES

Table D-1

SOLID WASTES GENERATED BEFORE APRIL 1973
JOHNS-MANVILLE
WAUKEGAN, ILLINOIS

Product	Annual Quantity	Estimated Percent Asbestos	Status
Auto and industrial lining	130,000 lb	55%	Discontinued 4/30/73
Brake blocks	315,000 lb	65	Discontinued 2/1/73
No. 6401 brake blocks	16,000 lb	39	Discontinued 2/1/73
1257 tan brake blocks	89,000 lb	65	Discontinued 2/1/73
Friction materials sludge	32,000 lb	60	Discontinued 5/1/73
#60 Service sheet	838,000 lb	80	Cut gasket discontinued 12/15/72; reject sheet sold at discount to gasket cutters
#61 Service sheet	200,000 lb	80	Cut gasket discontinued 12/15/72; reject sheet sold at discount to gasket cutters
Disc brakes	Included in F.M. sludge	60	Discontinued 4/30/73
Steel back clutch facings	10,000 lb	60	Discontinued 2/1/73
Transite pipe	5,800,000 lb or 2,900 tons	15	Recycled

Source: Ramp

Table D-2

SOLID WASTES DISPOSED OF AS OF APRIL 1973
JOHNS-MANVILLE
WAUKEGAN, ILLINOIS

Product	Annual Quantity	Estimated Percent Asbestos	Status
Millboard	25,000 lb	80%	No sheet material
Flexboard and Transitop	2,250,000 lb	22	Trim, scrap, and dust
Saturating felt	5,472,000 lb or 2,736 tons	50	No use found
Asphalt roll roofing	13,344,000 lb or 6,672 tons	17	1/3 asbestos felt 2/3 organic felt
Transite pipe	8,748,000 lb or 4,373 tons dry	15	Excess of recycle
	572,000 lb or 286 tons wet	15	Wet end collector

Source: Ramp

Table D-3

HAZARDOUS WASTES GENERATED AND DISPOSED OF ONSITE
BEFORE AUGUST 18, 1980
JOHNS-MANVILLE
WAUKEGAN, ILLINOIS

Substance	Monthly Quantity
Raw asbestos[a]	750 lb
Chromium	14 lb
Lead	4 lb
Xylene	300 lb
Thiram	1 lb plus 8 inner liners

[a]Raw asbestos is non-incorporated fibers.

Source: Ramp

Table D-4

HAZARDOUS WASTES DISPOSED OF IN AN ENCAPSULATED FORM
BEFORE AUGUST 18, 1980
JOHNS-MANVILLE
WAUKEGAN, ILLINOIS

Substance	Monthly Quantity (lb)
Asbestos	14,190
Chromium	3,077
Lead	298
Thiram	136

Source: Ramp

APPENDIX E

SOIL BORING LOGS DATA SHEETS

SOIL BORING AND MONITORING WELL LOCATION COORDINATES

KMA
• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES, INC
3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE / Time Sept 11, 1984 (1:47-5:30pm)

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill.

LOCATION See Map (p. J-2)

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 1

SURFACE ELEV. 613.0'

LE PLUGGED WITH Cement & Bentonite

BORING LOCATION

Grid: 8,103.645 North
11, 407.718 East

BORING DEPTH (Ft.) FROM	TO		DEPTH OF TEST	NO. BLOWS 1st 6"	NO. BLOWS 2nd 6"	NO. BLOWS 3rd 6"	NO. BLOWS LAST 12"
0	9.0	Sludge, fiber	1.5	1	1	1	2
9.0	26.5	Sludge, fiber, moist	3.0	←	1	→	1
26.5	30.5	Sand, black tar like with some stones and service board	4.5	←	1	→	1
			6.0	←	1	→	1
			7.5	←	1	→	1
			9.0	←	1	→	1
			11.5	←	1	→	1
			14.0	←	1	→	1
			16.5	←	1	→	1
			19.0	←	1	→	1
			21.5	←	2	→	2
			24.0	pushed			
			26.5	6	10	14	24
			29.0	5	2	2	4
			31.5	←	1	→	1

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER ____ HRS _____ FT.

BORING CAVE IN 25.66 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

KMA
• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES, INC.

3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE / Time Sept 12, 1984 (9:30-11:2(

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill

LOCATION See Map

EQUIPMENT CMa 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 2

SURFACE ELEV. 615.2'

HOLE PLUGGED WITH Cement & Bentonite

BORING LOCATION

Grid: 8,102.959 North
12,059.802 East

BORING DEPTH (Ft.) FROM	TO		DEPTH OF TEST	NO. BLOWS 1st 6"	NO. BLOWS 2nd 6"	NO. BLOWS 3rd 6"	NO. BLOWS LAST 12"
0	16.5	Sludge.	0	1	2	1	3
16.5	19.0	Sand, fine, shingle sand, moist	1.5	1	2	2	
19.0	26.5	Sludge, moist	4.0	←	2	→	3
26.5	28.0	Sludge with 2" layer of shingle sand	6.5	←	1	→	
28.0	31.5	Sludge	9.0	←	2	→	2
31.5	34.0	Sludge, marl, sand, layered	11.5	←	1	→	
34.0	35.5	Sand & gravel layers, black	14.0	←	1	→	1
			16.5	2	4	2	
			19	←	1	→	1
			21.5	1	1	1	2
			24	←	2	→	2
			26.5	7	9	9	8
			29	7	9	14	23
			31.5	6	2	2	4
			34	6	20	42	2

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER ____ HRS _____ FT.

BORING CAVE IN 27.16 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

KMA
• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES, INC.
3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE / Time Sept 17, 1984 (8:30-11:05am)

PERMIT NO.

PROJECT Johns-Manville, Waukegon, Ill

LOCATION See Map

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 3

SURFACE ELEV. 589.4'

HOLE PLUGGED WITH Cement & Bentonite

BORING LOCATION

Grid: 7,522.115 North
12,110.323 East

BORING DEPTH (Ft) FROM	TO		NO. BLOWS LAST 12"	NO. BLOWS 3rd 6"	NO. BLOWS 2nd 6"	NO. BLOWS 1st 6"	DEPTH OF TEST
0	2.5	Road gravel, cinders	0	4	8	10	18
2.5	5.0	Sand, fine to med., black, waterbearing	4	4	7	8	15
5.0	9.0	Sand, fine to med., tan, waterbearing	9	27	25	24	49
9.0	14.0	Sand fine to med. & gravel, fine to med., waterbearing	14	5	8	16	24
14.0	37.0	Sand, fine to med., waterbearing					
37.0	39.5	Sand, fine to very fine, silty, waterbearing					
39.5	40.0	Clay, occ. stone, gray					

GROUNDWATER:

ENCOUNTERED AT _____ FT.

AFTER COMPLETION _____ FT.

AFTER _____ HRS _____ FT.

BORING CAVE IN 1.5 FT.

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT. ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

KVA

• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES, INC

3000 East Bell Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE / Time Sept 12, 1984 (1:30-4:30 p)

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill

LOCATION See Map

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 4

SURFACE ELEV. 595.2'

HOLE PLUGGED WITH Cement & Bentonite

BORING LOCATION

Grid: 8,027.120 North
12,825.040 East

BORING DEPTH (Ft) FROM	TO		DEPTH OF TEST	NO. BLOWS 1st 6"	NO. BLOWS 2nd 6"	NO. BLOWS 3rd 6"	NO. BLOWS LAST 12"
0	9.0	Sludge, brich, concrete (6.5-9.0 moist)	0	4	8	8	16
9.0	13.0	Wood	1.5	2	3	4	
13.0	15.5	Sand, fine, black, waterbearing	4.0	1	1	2	3
			6.5		1		
			9.0	25	67	47	11
			11.5	92	68	17	2
			14	6	4	3	

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER _____ HRS _____ FT.

BORING CAVE IN 8.0 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

KVA

• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES, INC.

3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE / Time Sept 17, 1984 (2:00-3:15pm)

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill

LOCATION See Map

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 5

SURFACE ELEV. 587.2'

LE PLUGGED WITH Bentonite

BORING LOCATION

Grid: 8,766.143 North
13,313.880 East

BORING DEPTH (Ft) FROM	TO		NO. BLOWS LAST 12"	NO. BLOWS 3rd 6"	NO. BLOWS 2nd 6"	NO. BLOWS 1st 6"	DEPTH OF TEST
							0
0	1.5	Sand, fine, beach	4	4	7	4	11
1.5	3.0	Sand, fine, beach, cobbls & gravel					
3.0	12.0	Sand, fine, beach, cobbles & gravel, waterbearing					
12.0	13.0	Sand, fine to med., occ stone, waterbearing					
13.0	15.0	Sand, fine to med.& gravel, fine to med.,cobbles waterbearing					
15.0	30.0	Sand, fine to med., gravelly, fine, waterbearing					
30.0	38.5	Sand, fine to very fine					
38.5	40.0	Clay, gray, occ. fine stone					

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER ____ HRS _____ FT.

BORING CAVE IN 1.5 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

KMA
• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES, INC.
3000 East Bell Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE / Time Sept 13, 1984 (3:00-4:30p)

PERMIT NO. _____

PROJECT Johns-Manville, Waukegan, Ill

LOCATION See Map

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 6

SURFACE ELEV. 613.0'

HOLE PLUGGED WITH Cement & Bentonite

BORING LOCATION

Grid: 9,144.640 North
10,696.141 East

BORING DEPTH (Ft) FROM	TO		DEPTH OF TEST	NO. BLOWS 1st 6"	NO. BLOWS 2nd 6"	NO. BLOWS 3rd 6"	NO. BLOWS LAST 12"	
0	2.0	Ash, shingles, brick, stones	0	3	15	14	2	
2.0	9.0	Cinders & shingles layers	1.5	3	7	4		
9.0	10.5	Wood & voids, water	4	2	2	2	6	
10.5	14.0	Sludge, gray & reddish layers	6.5	←	1	→		
14.0	19.0	Cinders & sludge, layered	9	10	4	1		
19.0	24.0	Sludge, water (very little soil retention in spoon)						
24.0	25.5	Sand, fine, color lightening with depth from	11.5	←	1	→	1	
		black to tan	14	←	1	→	5	5
			16.5	22	37	14	4	
			19	1	1	3	4	
			21.5	←	0	→	0	
			24	1	3	10	13	

GROUNDWATER:

ENCOUNTERED AT 7.8 FT

AFTER COMPLETION _____ FT

AFTER ____ HRS _____ FT.

BORING CAVE IN 8.0 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

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Grand Rapids, Michigan 49505
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CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE /Time Sept 14, 1984 (8:30-11:00am)

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill

LOCATION See Map

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 7

SURFACE ELEV. 615.6'

HOLE PLUGGED WITH Cement & Bentonite

BORING LOCATION

Grid: 9,550.905 North
10,132.841 East

BORING DEPTH (Ft) FROM	TO		DEPTH OF TEST	NO. BLOWS 1st 6"	NO. BLOWS 2nd 6"	NO. BLOWS 3rd 6"	NO. BLOWS LAST 12"
0	11.0	Cinders, shingles, sludge	0	6	8	7	15
11.0	14.0	Sludge with shingles and cinders	1.5	5	4	3	7
14.0	16.5	Sludge with shingles and cinders, wet	4	1	1	3	4
16.5	27.8	Sludge	24.5	14	22	23	45
27.8	30.5	Sand, fine, black, color turning to red. brown in the 29 ft. split-spoon	29	8	32	25	58
			11.5	5	6	3	1	4
			14		1		1
			16.5		1		1
			19	0	2	2	4
			21.5	1	1	1	2
			24	1	1	1	2
			26.5	1	1	2	3
			29	14	23	45	68

GROUNDWATER:

ENCOUNTERED AT _____ FT.

AFTER COMPLETION _____ FT.

AFTER ____ HRS _____ FT.

BORING CAVE IN 5 FT.

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

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CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE /Time Sept 17, 1984 (4:05-5:40 pm)

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill.

LOCATION See Map

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 8

SURFACE ELEV. 582.5'

HOLE PLUGGED WITH Natural Soils

BORING LOCATION

Grid: 10,159.369 North
10,173.709 East

BORING DEPTH (Ft) FROM	TO		NO. BLOWS LAST 12"	NO. BLOWS 3rd 6"	NO. BLOWS 2nd 6"	NO. BLOWS 1st 6"	DEPTH OF TEST
0	0.5	Sand, fine, moist, occ. stone	0	2	2	3	5
0.5	26.0	Sand, fine to med., waterbearing	4	7	11	18	
26.0	33.0	Clay, occ. fine stone, gray					

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER ____ HRS _____ FT.

BORING CAVE IN 0.5 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

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CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE /Time Sept 13, 1984 (8:15-10:10 am)

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill

LOCATION See Map

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 9

SURFACE ELEV. 612.9'

HOLE PLUGGED WITH Cement & Bentonite

BORING LOCATION

Grid: 8,358.081 North
11,002.337 East

BORING DEPTH (ft.) FROM	TO		DEPTH OF TEST	NO. BLOWS 1st 6"	NO. BLOWS 2nd 6"	NO. BLOWS 3rd 6"	NO. BLOWS LAST 12"
0	14.0	Sludge.	0	1	1	1	2
14.0	20.0	Sludge, moist with wet lense like areas	1.5	←	1	→	1
20.0	22.8	Gravel, fine to med., fill	4	←	2	→	2
22.8	23.0	Shingles	6.5	←	2	→	2
23.0	29.0	Shingles, gravel, sludge	9	←	1	→	1
29.0	30.5	Sand, fine, black, waterbearing	11.5	←	1	→	1
			14	←	1	→	1
			16.5	←	2	→	2
			19	1	1	3	3
			21.5	3	7	10	17
			24	13	14	24	38
			26.5	3	6	10	16
			29	3	5	7	12

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER ____ HRS _____ FT.

BORING CAVE IN 8.0 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

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CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE /Time Sept 18, 1984 (8:25-9:45)

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill

LOCATION See Map

EQUIPMENT CME 45 6" augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 10

SURFACE ELEV. 588.4'

HOLE PLUGGED WITH Cement & Bentonite

BORING LOCATION

Grid: 8,866.236 North
8,453.392 East

BORING DEPTH (Ft) FROM	TO		NO. BLOWS LAST 12"	NO. BLOWS 3rd 6"	NO. BLOWS 2nd 6"	NO. BLOWS 1st 6"
		DEPTH OF TEST	0	1	2	4
0	0.8	Topsoil, cinders	4	4	5	5
0.8	5.0	Sand, fine, tan, dry	9	1	1	2
5.0	22.0	Sand, fine to med., tan, waterbearing				
22.0	25.0	Sand, fine, waterbearing				
25.0	34.0	Clay, gray, occ. fine stone				

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER _____ HRS _____ FT.

BORING CAVE IN 3.6 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

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CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE / Time Sept 19, 1984 (12:05-12:28pm

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill.

LOCATION 85ft. S & 33ft. W of the NE fence corner of the "north 40"

EQUIPMENT CME 45 6" augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 11

SURFACE ELEV. 584.4'

HOLE PLUGGED WITH Natural Soils

BORING LOCATION

Grid: 11,230.498 North
10,309.609 East

BORING DEPTH (ft) FROM	TO		NO. BLOWS LAST 12"	NO. BLOWS 3rd 6"	NO. BLOWS 2nd 6"	NO. BLOWS 1st 6"	DEPTH OF TEST
0	2.0	Sand, fine to med., occ. fine stone with trace of topsoil	12	12	7	.5	24
			16	13	7	4	29
2.0	4.0	Sand, fine to coarse & gravel, fine, waterbearing					
4.0	5.5	Sand, fine to med., occ. fine stone. waterbearing					

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER ____ HRS _____ FT.

BORING CAVE IN 2.0 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

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CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE /Time Sept 19, 1984 (12:35-12:5p

PERMIT NO.

PROJECT Johns-Manville, Waukegan, Ill.

LOCATION 185 ft E & 30 ft S of the NW fence corner of the "north 40"

EQUIPMENT CME 75 6" Hs augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 12

SURFACE ELEV. 586.3'

HOLE PLUGGED WITH Natural Soils

BORING LOCATION

Grid; 11,286.558 North
8,927.484 East

BORING DEPTH (Ft) FROM	TO		NO. BLOWS LAST 12"	NO. BLOWS 3rd 6"	NO. BLOWS 2nd 6"	NO. BLOWS 1st 6"	DEPTH OF TEST
0	0.5	Topsoil	1.5	4	4	7	11
0.5	3.0	Sand, fine	4	7	8	10	1
3.0	5.5	Sand, fine, waterbearing					

GROUNDWATER:

ENCOUNTERED AT _____ FT

AFTER COMPLETION _____ FT

AFTER ____ HRS _____ FT.

BORING CAVE IN 3.0 FT

WELL DATA:

CASING USED: TYPE _____

DIAMETER _____

LENGTH _____

SCREEN LENGTH & SLOT SIZE _____

HT ABOVE GROUND _____

SOIL BORING/WELL LOG DATA SHEET

SHEET ____ OF ____

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CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE / Time Sept 19, 1984 (1:00-1:15pm)

PERMIT NO. ____

PROJECT Johns-Manville, Waukegan, Ill.

LOCATION 15 ft N & 10 ft W of the NW corner of the pond in "north 40"

EQUIPMENT CME 45 6" HS augers

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 13

SURFACE ELEV. 585.8'

HOLE PLUGGED WITH Natural Soils

BORING LOCATION

Grid: 10,353.410 North
8,659.999 East

BORING DEPTH (Ft) FROM	TO		NO. BLOWS LAST 12"	NO. BLOWS 3rd 6"	NO. BLOWS 2nd 6"	NO. BLOWS 1st 6"	DEPTH OF TEST
0	1.0	Cinders	5	8	9	17	1.5
1.0	2.5	Sand, fine to med., waterbearing	5	7	13	20	4

GROUNDWATER:

ENCOUNTERED AT ____ FT

AFTER COMPLETION ____ FT

AFTER ____ HRS ____ FT.

BORING CAVE IN 2.5 FT

WELL DATA:

CASING USED: TYPE ____

DIAMETER ____

LENGTH ____

SCREEN LENGTH & SLOT SIZE ____

HT. ABOVE GROUND ____

SHEET ____ OF ____

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CLIENT Johns-Manville

PROJECT NO. S94-3224

DATE /Time Sept 19, 1984 (1:45-1:50)

PERMIT NO. ____

PROJECT Johns-Manville, Waukegan, Ill.

LOCATION 123 ft N & 15 ft W of the NE corner of the pond in the "N 40"

EQUIPMENT Hand auger

TECHNICIAN Larry Austin & Herman DeLano

BORING NO. 14

SURFACE ELEV. 583.0'

HOLE PLUGGED WITH Natural Soils

BORING LOCATION

Grid: 10,562.279 North
9,750.761 East

BORING DEPTH (Ft) FROM	TO		NO. BLOWS LAST 12"	NO. BLOWS 3rd 6"	NO. BLOWS 2nd 6"	NO. BLOWS 1st 6"	DEPTH OF TEST
0	1.3	Sand, fine, moist					
1.3	1.5	Sand, fine, waterbearing					

GROUNDWATER:

ENCOUNTERED AT ____ FT

AFTER COMPLETION ____ FT

AFTER ____ HRS ____ FT.

BORING CAVE IN 1.3 FT

WELL DATA:

CASING USED: TYPE ____

DIAMETER ____

LENGTH ____

SCREEN LENGTH & SLOT SIZE ____

HT ABOVE GROUND ____

SOIL BORING AND MONITORING WELL LOCATION COORDINATES

Reference Point — Iron Pipe SW of Boring 8 with Coordinates of 10,000 N and 10,000 E

Soil Boring Number	North Coordinate in Feet	East Coordinate in Feet	Elev.
1	8,103.645	11,407.718	612.99
2	8,102.959	12,059.802	615.19
3	7,522.115	12,110.323	589.43
4	8,027.120	12,825.040	595.17
5	8,766.143	13,313.880	587.19
6	9,144.640	10,696.141	613.04
7	9,550.905	10,132.841	615.64
8	10,159.369	10,173.709	582.48
9	8,358.081	11,002.337	612.87
10	8,866.236	8,453.392	588.41
11	11,230.498	10,309.609	584.42
12	11,286.558	8,927.484	586.27
13	10,353.410	8,659.999	585.80
14	10,562.279	9,750.761	583.02
Well Site			
1	7,526.322	11,804.300	591.16
2	7,629.600	13,257.249	587.88
3	8,604.949	13,276.405	588.92
4	9,757.456	13,271.289	587.20
5	8,869.430	8,463.178	588.00

APPENDIX F

LABORATORY TEST RESULTS

- SOIL SAMPLES
- GROUNDWATER SAMPLES

KUMAR MALHOTRA
ASSOCIATES
ANALYTICAL REPORT
September 17, 1984

SOIL SAMPLES

CAL
Canton Analytical Laboratory, Inc.
P. O. Box 1129 ☐ 153 Elder Street
Ypsilanti, Michigan 48197
(313) 483-7430

ADDENDUM

To reports for Canton Analytical Laboratories samples 4090698 to 4090705 (Soils), 4090501 to 4090523 (Soils) and 4090939 to 4090945 (Waters).

All soil samples except for the soil blanks should have the results for asbestos changed as follows:

FROM	0%
TO	<1%

The asbestos concentration for the water samples should be changed to read as follows:

FROM	N.D.
TO	<50,000 Fibers /liter

KUM(MALHOTRA ASSOCIATES (

SAMPLES RECEIVED 09/17/84 PAGE 1

LAB# 4090501 B-1 NEAR SURFACE
LAB# 4090502 B-1 14-15.5 FEET
LAB# 4090503 B-1 31.5 @ 33 FEET
LAB# 4090504 B-2 SURFACE
LAB# 4090505 B2 21.5 - 23 FEET
LAB# 4090506 B2-34 - 35.5 FEET

LAB#	4090501	4090502	4090503	4090504	4090505	4090506
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG Wi
ISBESTOS, % OF BULK SAMPLE	0	0	0	0	0	0
LUMINUM, TOTAL	2100	1400	1300	3500	2100	2000
HROMIUM, TOTAL	16	29	9.0	81	42	6.6
ARIUM, TOTAL	49	820	220	570	580	140
ERYLLIUM, TOTAL	(0.20	(0.20	(0.20	(0.20	(0.20	(0.20
OBALT, TOTAL	0.80	5.8	1.9	6.9	6.4	2.2
OPPER, TOTAL	12	160	71	130	590	39
RON, TOTAL	810	2200	3300	4300	4700	4800
ICKEL, TOTAL	28	76	25	200	130	24
ANGANESE, TOTAL	45	120	130	150	140	250
INC, TOTAL	73	1700	360	1500	1400	140
ANADIUM	(2	29	17	14	18	17
ILVER, TOTAL	1.4	4.8	1.8	2.8	3.6	2.4

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090501	4090502	4090503	4090504	4090505	409050E
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
ARSENIC, TOTAL	0.60	0.15	0.62	2.4	3.2	0.62
ANTIMONY, TOTAL	(0.3	(0.3	(0.3	(0.3	(0.3	(0.3
SELENIUM, TOTAL	0.09	0.23	0.04	0.04	0.09	(0.04
THALLIUM, TOTAL	(0.40	25	(0.40	(0.40	8.0	(0.40
MERCURY, TOTAL	0.08	0.01	0.03	0.04	0.04	0.01
TIN, TOTAL	(20	(20	(20	(20	(20	(20
CADMIUM, TOTAL	0.6	1.0	1.0	(0.20	1.2	1.0
LEAD, TOTAL	86	3700	630	1100	2600	190
BORON	4.9	14	3.0	5.3	9.4	2.2
NITROGEN, AMMONIA AS N	11	26	24	12	130	13
CYANIDE, TOTAL	2.2	2.8	1.5	1.1	0.29	< 0.10
SULFIDES, as S	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
PURGEABLES-31 CPDS, GC						
ACROLEIN	< 1	< 1	< 1	< 1	< 1	< 1
ACRYLONITRILE	< 1	< 1	< 1	< 1	< 1	< 1
BENZENE	(0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
TOLUENE	(0.02	0.31	0.14	< 0.02	0.51	< 0.02
ETHYLBENZENE	(0.02	< 0.02	< 0.02	0.02	0.08	< 0.02

CAL

LAB#	4090501	4090502	4090503	4090504	4090505	4090506
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
CARBON TETRACHLORIDE	<0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
CHLOROBENZENE	<0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
1,2-DICHLOROETHANE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,1-TRICHLOROETHANE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHANE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHENE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2-TRICHLOROETHANE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CHLOROETHANE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2-CHLOROETHYL VINYL ETHER	<0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
CHLOROFORM	<0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,2-DICHLOROPROPANE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CIS-1,3-DICHLOROPROPENE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRANS-1,3-DICHLOROPROPENE	<0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
METHYLENE CHLORIDE	<0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL CHLORIDE	<0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL BROMIDE	<0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
BROMOFORM	<1	< 1	< 1	< 1	< 1	< 1
DICHLOROBROMOMETHANE	<0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090501	4090502	4090503	4090504	4090505	4090506
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WI
TRICHLOROFLUOROMETHANE	(0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
DICHLORODIFLUOROMETHANE	(0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
DIBROMOCHLOROMETHANE	(0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
TETRACHLOROETHENE	(0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRICHLOROETHENE	(0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
VINYL CHLORIDE	(0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
TRANS-1,2-DICHLOROETHENE	(0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
,1,2,2-TETRACHLOROETHANE	(0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
)-XYLENE	(0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
YLENES	(0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
ASE/NEUTRALS-46 CPDS, GC						
I-N-BUTYLPHTHALATE	<0.028	0.31	0.74	<0.028	1.2	0.28
,2-DICHLOROBENZENE	0.12	0.27	< 0.028	0.58	0.75	< 0.028
,3-DICHLOROBENZENE	< 0.028	<0.028	< 0.028	0.077	0.061	< 0.028
,4-DICHLOROBENZENE	< 0.028	<0.028	< 0.028	< 0.028	< 0.028	< 0.028
EXACHLOROETHANE	< 0.028	<0.028	< 0.028	< 0.028	< 0.028	< 0.028
EXACHLOROBUTADIENE	< 0.028	<0.028	< 0.028	< 0.028	< 0.028	< 0.028
EXACHLOROBENZENE	< 0.028	< .028	< 0.028	< .028	< 0.028	< 0.028

CAL

LAB#	4090501	4090502	4090503	4090504	4090505	4090506
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
1,2,4-TRICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-CHLOROETHOXY) METHANE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2-CHLORONAPHTHALENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ISOPHORONE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
NITROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2,4-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
2,6-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
4-BROMOPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-ETHYLHEXYL) PHTHALATE	3.6	2.5	3.3	4.6	14	5.1
DI-N-OCTYL PHTHALATE	< 0.028	0.55	0.49	< 0.028	1.5	3.3
DIMETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
FLUORENE	< 0.028	0.051	< 0.028	< 0.028	0.18	< 0.028
FLUORANTHENE	0.12	0.053	0.035	0.085	0.33	0.20
CHRYSENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
PYRENE	0.13	0.089	0.043	0.098	0.30	0.19
PHENANTHRENE	0.046	0.16	< 0.055	0.19	0.56	0.060
ANTHRACENE	< 0.028	0.037	< 0.028	< 0.028	0.15	< 0.028
BENZO(A)ANTHRACENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	0.29

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090501	4090502	4090503	4090504	4090505	4090506
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
BENZO(B)FLUORANTHENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	0.16
BENZO(K)FLUORANTHENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	0.075
BENZO(A)PYRENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
DIBENZO(A,H)ANTHRACENE	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083
BENZO(GHI)PERYLENE	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083
4-CHLOROPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
3,3'-DICHLOROBENZIDINE	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069
BENZIDINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-CHLOROETHYL) ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
1,2-DIPHENYLHYDRAZINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
HEXACHLOROCYCLOPENTADIENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODIPHENYLAMINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ACENAPHTHYLENE	< 0.028	< 0.028	< 0.028	< 0.028	0.14	< 0.028
ACENAPHTHENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BUTYL BENZYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODIMETHYLAMINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODI-N-PROPYLAMINE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
BIS(2-CHLOROISOPROPYL) ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

CAL

LAB#	4090501	4090502	4090503	4090504	4090505	4090506
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
DIETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
INDENO(1,2,3-CD)PYRENE	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069
NAPHTHALENE	0.054	0.78	0.089	0.050	1.8	< 0.028
ACID EXTRACTS-11 CPDS, GC						
PHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2-NITROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
4-NITROPHENOL	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2,4-DINITROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
4,6-DINITRO-O-CRESOL	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
PENTACHLOROPHENOL	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
P-CHLORO-M-CRESOL	0.42	1.0	<0.02	<0.02	0.47	<0.02
2-CHLOROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2,4-DICHLOROPHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4,6-TRICHLOROPHENOL	< 0.03	< 0.03	< 0.03	< 0.03	0.45	< 0.03
2,4-DIMETHYLPHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PESTICIDES/PCB'S-26 CPDS, GC						
ALPHA ENDOSULFAN	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	<0.014
BETA ENDOSULFAN	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090501	4090502	4090503	4090504	4090505	4090506
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
ENDOSULFAN SULFATE	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066
BHC, ALPHA	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
BHC, BETA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
BHC, DELTA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
BHC, GAMMA	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ALDRIN	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
DIELDRIN	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
4,4'-DDE	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
4,4'-DDD	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
4,4'-DDT	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012
HEPTACHLOR	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009
HEPTACHLOR EPOXIDE	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
CHLORDANE	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
TOXAPHENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PCB-1016	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1221	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1232	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1242	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

CAL

LAB#	4090501	4090502	4090503	4090504	4090505	4090506
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
PCB-1248	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1254	0.2	0.2	< 0.1	0.3	0.2	< 0.1
PCB-1260	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TETRACHLORODIBENZO-P-DIOXIN	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
ENDRIN	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ENDRIN ALDEHYDE	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023
THIRAM	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB# 4090507 B4- BLANK (FIELD)
LAB# 4090508 B4- NEAR SURFACE
LAB# 4090509 B4-6.5 - 8 FEET
LAB# 4090510 B4-14 - 15.5 FEET
LAB# 4090511 B6- SURFACE
LAB# 4090512 B6-NEAR SURFACE

LAB#	4090507	4090508	4090509	4090510	4090511	4090512
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WI
ASBESTOS, % OF BULK SAMPLE	0	0	0	0	0	<1
ALUMINUM, TOTAL	85	5600	1600	1400	3100	3500
CHROMIUM, TOTAL	3.8	4.4	25	5.8	29	5.4
BARIUM, TOTAL	(2.0	24	520	29	61	140
BERYLLIUM, TOTAL	(0.20	(0.20	(0.20	(0.20	(0.20	(0.20
COBALT, TOTAL	(0.20	(0.20	2.6	0.40	4.0	1.4
COPPER, TOTAL	3.2	12	93	18	940	58
IRON, TOTAL	91	1100	190	2200	4900	4400
NICKEL, TOTAL	3.8	13	66	13	69	29
MANGANESE, TOTAL	1.8	36	120	78	190	98
ZINC, TOTAL	3.8	24	1200	69	1500	310
VANADIUM	21	6.8	12	26	25	22
SILVER, TOTAL	(0.20	2.2	2.4	0.80	3.4	1.4

CAL

KUMA MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090507	4090508	4090509	4090510	4090511	4090512
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
RSENIC, TOTAL	0.08	0.37	0.35	0.28	1.5	0.43
NTIMONY, TOTAL	(0.3	(0.3	(0.3	(0.3	(0.3	(0.3
ELENIUM, TOTAL	(0.04	(0.04	0.09	0.07	0.23	0.16
HALLIUM, TOTAL	(0.40	(0.40	(0.40	4.0	(0.40	(0.40
ERCURY, TOTAL	(0.01	0.02	0.04	0.08	0.16	0.07
IN, TOTAL	(20	(20	(20	(20	(20	(20
ADMIUM, TOTAL	0.4	1.0	1.0	0.6	1.0	0.9
EAD, TOTAL	2.4	22	1400	140	2200	330
ORON	3.9	20	5.5	1.7	5.3	5.6
ITROGEN, AMMONIA AS N	<9.7	13	17	13	12	< 10
YANIDE, TOTAL	< 0.10	< 0.10	0.43	< 0.10	< 0.10	< 0.10
ULFIDES, as S	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
URGEABLES-31 CPDS, GC						
CROLEIN	< 1	< 1	< 1	< 1	< 1	< 1
CRYLONITRILE	< 1	< 1	< 1	< 1	< 1	< 1
ENZENE	< 0.02	< 0.02	< 0.02	0.06	< 0.02	< 0.02
OLUENE	< 0.02	0.31	< 0.02	0.62	< 0.02	< 0.02
THYLBENZENE	< 0.02	< 0.02	< 0.02	1.4	< 0.02	< 0.02

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB# / UNITS	4090507 MG/KG WET	4090508 MG/KG WET	4090509 MG/KG WET	4090510 MG/KG WET	4090511 MG/KG WET	409051 MG/KG
CARBON TETRACHLORIDE	< 0.5	< 0.8	< 0.8	< 0.5	< 0.5	< 0.8
CHLOROBENZENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
1,2-DICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,1-TRICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2-TRICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2-CHLOROETHYL VINYL ETHER	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
CHLOROFORM	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,2-DICHLOROPROPANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CIS-1,3-DICHLOROPROPENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRANS-1,3-DICHLOROPROPENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
METHYLENE CHLORIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL CHLORIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL BROMIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
BROMOFORM	< 1	< 1	< 1	< 1	< 1	< 1
DICHLOROBROMOMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB# / UNITS	4090507 MG/KG WET	4090508 MG/KG WET	4090509 MG/KG WET	4090510 MG/KG WET	4090511 MG/KG WET	4090512 MG/KG WE
TRICHLOROFLUOROMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
DICHLORODIFLUOROMETHANE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
DIBROMOCHLOROMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
TETRACHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
VINYL CHLORIDE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
TRANS-1,2-DICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2,2-TETRACHLOROETHANE	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
O-XYLENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
XYLENES	<0.02	<0.02	<0.02	<0.02	< 0.02	< 0.02
BASE/NEUTRALS-46 CPDS, GC						
DI-N-BUTYLPHTHALATE	0.53	0.31	0.14	0.26	0.27	0.18
1,2-DICHLOROBENZENE	< 0.028	< 0.028	<0.028	0.20	< 0.028	<0.028
1,3-DICHLOROBENZENE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	<0.028
1,4-DICHLOROBENZENE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	<0.028
HEXACHLOROETHANE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	<0.028
HEXACHLOROBUTADIENE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	<0.028
HEXACHLOROBENZENE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	<0.028

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090507	4090508	4090509	4090510	4090511	4090512
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
1,2,4-TRICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-CHLOROETHOXY) METHANE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2-CHLORONAPHTHALENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ISOPHORONE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
NITROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2,4-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
2,6-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
4-BROMOPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-ETHYLHEXYL) PHTHALATE	24	8.0	3.5	4.2	5.2	4.0
DI-N-OCTYL PHTHALATE	9.0	1.7	1.0	0.52	< 0.028	2.5
DIMETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
FLUORENE	< 0.028	0.077	< 0.028	0.43	< 0.028	0.032
FLUORANTHENE	< 0.028	0.093	< 0.028	0.34	0.28	0.50
CHRYSENE	< 0.028	< 0.028	< 0.028	< 0.028	0.12	0.23
PYRENE	< 0.028	< 0.028	0.046	0.33	0.33	0.48
PHENANTHRENE	< 0.055	0.15	0.062	0.57	0.18	0.59
ANTHRACENE	< 0.028	< 0.028	< 0.028	0.092	0.051	0.21
BENZO(A)ANTHRACENE	< 0.055	< 0.055	< 0.055	< 0.055	0.23	0.42

CAL

LAB#	4090507	4090508	4090509	4090510	4090511	4090512
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
BENZO(B)FLUORANTHENE	< 0.055	< 0.055	<0.055	< 0.055	0.37	0.38
BENZO(K)FLUORANTHENE	< 0.055	< 0.055	<0.055	< 0.055	0.44	< 0.055
BENZO(A)PYRENE	< 0.055	< 0.055	<0.055	< 0.055	< 0.055	0.15
DIBENZO(A,H)ANTHRACENE	< 0.083	< 0.083	<0.083	< 0.083	< 0.083	< 0.083
BENZO(GHI)PERYLENE	< 0.083	< 0.083	<0.083	< 0.083	< 0.083	< 0.083
4-CHLOROPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
3,3'-DICHLOROBENZIDINE	< 0.069	< 0.069	<0.069	< 0.069	< 0.069	< 0.069
BENZIDINE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
BIS(2-CHLOROETHYL) ETHER	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
1,2-DIPHENYLHYDRAZINE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
HEXACHLOROCYCLOPENTADIENE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
N-NITROSODIPHENYLAMINE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
ACENAPHTHYLENE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
ACENAPHTHENE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
BUTYL BENZYL PHTHALATE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
N-NITROSODIMETHYLAMINE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
N-NITROSODI-N-PROPYLAMINE	< 0.055	< 0.055	<0.055	< 0.055	< 0.055	< 0.055
BIS(2-CHLOROISOPROPYL) ETHER	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028

CAL

LAB#	4090507	4090508	4090509	4090510	4090511	4090512
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
DIETHYL PHTHALATE	< 0.028	< 0.028	<0.028	< 0.028	< 0.028	< 0.028
INDENO(1,2,3-CD)PYRENE	< 0.069	< 0.069	<0.069	< 0.069	< 0.069	< 0.069
NAPHTHALENE	< 0.028	0.95	0.097	2.1	0.22	0.16
ACID EXTRACTS-11 CPDS, GC						
PHENOL	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01
2-NITROPHENOL	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02
4-NITROPHENOL	< 0.2	< 0.2	<0.2	< 0.2	< 0.2	< 0.2
2,4-DINITROPHENOL	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02
4,6-DINITRO-O-CRESOL	< 0.6	< 0.6	<0.6	< 0.6	< 0.6	< 0.6
PENTACHLOROPHENOL	< 0.3	< 0.3	<0.3	< 0.3	< 0.3	< 0.3
P-CHLORO-M-CRESOL	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02
2-CHLOROPHENOL	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02
2,4-DICHLOROPHENOL	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01
2,4,6-TRICHLOROPHENOL	< 0.03	< 0.03	<0.03	< 0.03	< 0.03	< 0.03
2,4-DIMETHYLPHENOL	< 0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01
PESTICIDES/PCB'S-26 CPDS, GC						
ALPHA ENDOSULFAN	< 0.014	< 0.014	<0.014	< 0.014	< 0.014	< 0.014
BETA ENDOSULFAN	< 0.064	< 0.064	<0.064	< 0.064	< 0.064	< 0.064

CAL

LAB# UNITS	4090507 MG/KG WET	4090508 MG/KG WET	4090509 MG/KG WET	4090510 MG/KG WET	4090511 MG/KG WET	409051 MG/KG
ENDOSULFAN SULFATE	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066
BHC, ALPHA	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
BHC, BETA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
BHC, DELTA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
BHC, GAMMA	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ALDRIN	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
DIELDRIN	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
4,4'-DDE	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
4,4'-DDD	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
4,4'-DDT	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012
HEPTACHLOR	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009
HEPTACHLOR EPOXIDE	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
CHLORDANE	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
TOXAPHENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PCB-1016	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1221	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1232	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1242	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090507	4090508	4090509	4090510	4090511	4090512
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
PCB-1248	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1254	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1260	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TETRACHLORODIBENZO-P-DIOXIN	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
ENDRIN	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ENDRIN ALDEHYDE	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023
THIRAM	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

-1-

CAL

SAMPLES RECEIVED 09/17/84

LAB# 4090513 B6-11.5 - 13 FEET
LAB# 4090514 B6-24 - 25.5 FEET
LAB# 4090515 B7- FIELD BLANK
LAB# 4090516 B7- NEAR SURFACE
LAB# 4090517 B7- NEAR SURFACE(REPLICATE)
LAB# 4090518 B7- 16.5-18 FEET

LAB#	4090513	4090514	4090515	4090516	4090517	4090518
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
ASBESTOS, % OF BULK SAMPLE	0	0	0	0	0	0
ALUMINUM, TOTAL	1400	1600	120	8200	6600	1700
CHROMIUM, TOTAL	18	6.4	3.6	22	18	14
BARIUM, TOTAL	410	510	3.6	360	330	10
BERYLLIUM, TOTAL	<0.20	<0.20	<0.20	< 0.20	< 0.20	< 0.20
COBALT, TOTAL	2.4	0.80	<0.20	2.6	2.2	0.60
COPPER, TOTAL	18	3000	0.50	21	21	1.4
IRON, TOTAL	1400	2900	100	6500	6200	1600
NICKEL, TOTAL	44	29	5.4	53	46	45
MANGANESE, TOTAL	120	59	2.0	380	250	240
ZINC, TOTAL	76	1200	1.2	64	83	5.6
VANADIUM	20	22	25	30	29	<2
SILVER, TOTAL	4.0	0.80	<0.20	2.6	2.4	0.40

CAL

LAB#	4090513	4090514	4090515	4090516	4090517	409051E
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
ARSENIC, TOTAL	0.17	0.22	0.12	0.22	0.32	0.20
ANTIMONY, TOTAL	< 0.3	<0.3	<0.3	<0.3	<0.3	<0.3
SELENIUM, TOTAL	0.12	<0.04	<0.04	0.22	0.28	0.15
THALLIUM, TOTAL	6.4	<0.40	<0.40	<0.40	<0.40	<0.40
MERCURY, TOTAL	0.21	0.34	<0.01	0.06	0.07	0.02
TIN, TOTAL	<20	< 20	< 20	< 20	<20	< 20
CADMIUM, TOTAL	1.2	1.0	<0.2	1.0	1.0	0.4
LEAD, TOTAL	2000	3900	<1.0	52	120	<1.0
BORON	6.1	7.4	2.7	16	21	4.6
NITROGEN, AMMONIA AS N	< 9.7	< 9.7	< 10	21	12	10
CYANIDE, TOTAL	0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
SULFIDES, as S	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
PURGEABLES-31 CPDS, GC						
ACROLEIN	<1	<1	<1	< 1	< 1	<1
ACRYLONITRILE	<1	<1	<1	< 1	< 1	< 1
BENZENE	<0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02
TOLUENE	<0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02
ETHYLBENZENE	<0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02

CAL

LAB#	4090513	4090514	4090515	4090516	4090517	4090518
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
CARBON TETRACHLORIDE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
CHLOROBENZENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
1,2-DICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,1-TRICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2-TRICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2-CHLOROETHYL VINYL ETHER	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
CHLOROFORM	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,2-DICHLOROPROPANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CIS-1,3-DICHLOROPROPENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRANS-1,3-DICHLOROPROPENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
METHYLENE CHLORIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL CHLORIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL BROMIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
BROMOFORM	< 1	< 1	< 1	< 1	< 1	< 1
DICHLOROBROMOMETHANE	< 0.8	0.8	< 0.8	< 0.8	< 0.8	< 0.8

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090513	4090514	4090515	4090516	4090517	4090518
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WI
TRICHLOROFLUOROMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
DICHLORODIFLUOROMETHANE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
DIBROMOCHLOROMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
TETRACHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
VINYL CHLORIDE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
TRANS-1,2-DICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2,2,-TETRACHLOROETHANE	< 0.2	< 0.2	<0.2	<0.2	<0.2	<0.2
O-XYLENE	< 0.02	< 0.02	<0.02	<0.02	<0.02	<0.02
XYLENES	< 0.02	< 0.02	<0.02	<0.02	<0.02	<0.02
BASE/NEUTRALS-46 CPDS, GC						
DI-N-BUTYLPHTHALATE	0.21	0.12	0.21	0.33	0.24	0.30
1,2-DICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	<0.028
1,3-DICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	<0.028
1,4-DICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	<0.028
HEXACHLOROETHANE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	<0.028
HEXACHLOROBUTADIENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	<0.028
HEXACHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	<0.028

CAL

LAB#	4090513	4090514	4090515	4090516	4090517	4090518
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
1,2,4-TRICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-CHLOROETHOXY) METHANE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2-CHLORONAPHTHALENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ISOPHORONE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
NITROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2,4-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
2,6-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
4-BROMOPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-ETHYLHEXYL) PHTHALATE	72	4.2	81	120	8.8	5.0
DI-N-OCTYL PHTHALATE	30	1.9	47	56	9.3	4.4
DIMETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
FLUORENE	0.10	0.031	< 0.028	< 0.028	< 0.028	< 0.028
FLUORANTHENE	0.14	0.12	< 0.028	0.29	0.14	< 0.028
CHRYSENE	< 0.028	< 0.028	< 0.028	0.19	0.087	< 0.028
PYRENE	0.14	0.11	< 0.028	0.35	0.18	< 0.028
PHENANTHRENE	0.19	0.27	< 0.028	0.40	0.27	< 0.028
ANTHRACENE	0.10	< 0.028	< 0.028	0.11	0.082	< 0.028
BENZO(A)ANTHRACENE	< 0.055	< 0.055	< 0.055	14	0.082	< 0.055

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB# / UNITS	4090513 MG/KG WET	4090514 MG/KG WET	4090515 MG/KG WET	4090516 MG/KG WET	4090517 MG/KG WET	4090518 MG/KG WE
BENZO(B)FLUORANTHENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
BENZO(K)FLUORANTHENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
BENZO(A)PYRENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
DIBENZO(A,H)ANTHRACENE	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083
BENZO(GHI)PERYLENE	0.038	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083
4-CHLOROPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
3,3'-DICHLOROBENZIDINE	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069
BENZIDINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-CHLOROETHYL) ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
1,2-DIPHENYLHYDRAZINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
HEXACHLOROCYCLOPENTADIENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODIPHENYLAMINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ACENAPHTHYLENE	< 0.028	0.032	< 0.028	< 0.028	< 0.028	< 0.028
ACENAPHTHENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BUTYL BENZYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODIMETHYLAMINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODI-N-PROPYLAMINE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
BIS(2-CHLOROISOPROPYL) ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/17/84

LAB#	4090513	4090514	4090515	4090516	4090517	4090518
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
DIETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
INDENO(1,2,3-CD)PYRENE	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069
NAPHTHALENE	0.10	0.26	< 0.028	0.15	0.16	< 0.028
ACID EXTRACTS-11 CPDS, GC						
PHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2-NITROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
4-NITROPHENOL	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2,4-DINITROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
4,6-DINITRO-O-CRESOL	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
PENTACHLOROPHENOL	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
P-CHLORO-M-CRESOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2-CHLOROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2,4-DICHLOROPHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4,6-TRICHLOROPHENOL	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
2,4-DIMETHYLPHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PESTICIDES/PCB'S-26 CPDS, GC						
ALPHA ENDOSULFAN	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
BETA ENDOSULFAN	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064

CAL

LAB#	4090513	4090514	4090515	4090516	4090517	4090518
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
ENDOSULFAN SULFATE	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066
BHC, ALPHA	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
BHC, BETA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
BHC, DELTA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
BHC, GAMMA	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ALDRIN	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
DIELDRIN	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
4,4'-DDE	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
4,4'-DDD	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
4,4'-DDT	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012
HEPTACHLOR	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009
HEPTACHLOR EPOXIDE	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
CHLORDANE	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
TOXAPHENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PCB-1016	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1221	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1232	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1242	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

CAL

LAB#	4090513	4090514	4090515	4090516	4090517	4090518
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WE
PCB-1248	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1254	0.4	< 0.1	< 0.1	0.9	2.0	< 0.1
PCB-1260	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TETRACHLORODIBENZO-P-DIOXIN	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
ENDRIN	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ENDRIN ALDEHYDE	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023
THIRAM	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

CAL

LAB# 4090519 B7- 16.5 - 18 FEET(REPLICATE)
LAB# 4090520 B7-29 - 30.5 FEET
LAB# 4090521 B9- NEAR SURFACE
LAB# 4090522 B9- 9-10.5 FEET
LAB# 4090523 B9- 29-30.5 FEET

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
ASBESTOS, % OF BULK SAMPLE	0	0	0	0	0
ALUMINUM, TOTAL	2500	900	1500	1700	1400
CHROMIUM, TOTAL	18	1.5	28	26	3.5
BARIUM, TOTAL	23	13	200	410	120
BERYLLIUM, TOTAL	<0.20	<0.20	<0.20	<0.20	<0.20
COBALT, TOTAL	0.80	<0.20	9.0	5.0	0.20
COPPER, TOTAL	2.8	11	33	11	9.4
IRON, TOTAL	2000	2200	2700	2000	3600
NICKEL, TOTAL	51	7.8	120	77	12
MANGANESE, TOTAL	310	54	120	100	150
ZINC, TOTAL	9.8	20	130	35	25
VANADIUM	<2	9.2	21	20	15
SILVER, TOTAL	0.80	<0.20	5.0	5.2	1.8
ARSENIC, TOTAL	0.38	0.13	<0.07	0.30	0.19

CAL

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
ANTIMONY, TOTAL	<0.3	<0.3	< 0.3	<0.3	<0.3
SELENIUM, TOTAL	0.43	<0.04	0.26	<0.04	<0.04
THALLIUM, TOTAL	<0.40	<0.40	20	22	<0.40
MERCURY, TOTAL	0.03	0.02	0.07	0.07	0.07
TIN, TOTAL	<20	<20	<20	<20	<20
CADMIUM, TOTAL	0.4	<0.2	1.0	1.0	1.0
LEAD, TOTAL	<1.0	<1.0	250	28	6
BORON	5.9	0.6	7.6	2.5	2.2
NITROGEN, AMMONIA AS N	10	<10	12	<9.8	13
CYANIDE, TOTAL	<0.10	<0.10	<0.10	<0.10	<0.10
SULFIDES, as S	<0.5	<0.5	<0.5	<0.5	<0.5
PURGEABLES-31 CPDS, GC					
ACROLEIN	<1	<1	<1	<1	<1
ACRYLONITRILE	<1	<1	<1	<1	<1
BENZENE	<0.02	<0.02	<0.02	<0.02	<0.02
TOLUENE	<0.02	<0.02	<0.02	<0.02	<0.02
ETHYLBENZENE	<0.02	<0.02	<0.02	<0.02	<0.02
CARBON TETRACHLORIDE	<0.8	<0.8	<0.8	<0.8	<0.8

CAL

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
CHLOROBENZENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
1,2-DICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,1-TRICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2-TRICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2-CHLOROETHYL VINYL ETHER	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
CHLOROFORM	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,2-DICHLOROPROPANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CIS-1,3-DICHLOROPROPENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRANS-1,3-DICHLOROPROPENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
METHYLENE CHLORIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL CHLORIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL BROMIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
BROMOFORM	< 1	< 1	< 1	< 1	< 1
DICHLOROBROMOMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
TRICHLOROFLUOROMETHANE	< 0.8	(< 0.8	< 0.8	(0.8	< 0.8

CAL

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
DICHLORODIFLUOROMETHANE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
DIBROMOCHLOROMETHANE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
TETRACHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
VINYL CHLORIDE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
TRANS-1,2-DICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2,2-TETRACHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
O-XYLENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
XYLENE	< 0.02	< 0.02	< 0.02	< 0.02	<0.02
BASE/NEUTRALS-46 CPDS, GC					
DI-N-BURYLPHTHALATE	0.18	0.081	< 0.028	< 0.028	0.054
1,2-DICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	0.032
1,3-DICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
1,4-DICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
HEXACHLOROETHANE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
HEXACHLOROBUTADIENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
HEXACHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
1,2,4-TRICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

CAL

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
BIS(2-CHLOROETHOXY) METHANE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2-CHLORONAPHTHALENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ISOPHORONE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
NITROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2,4-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
2,6-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
4-BROMOPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-ETHYLHEXYL) PHTHALATE	2.3	2.0	3.6	1.2	1.2
DI-N-OCTYL PHTHALATE	0.59	0.58	0.40	0.20	0.31
DIMETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
FLUORENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
FLUORANTHENE	< 0.028	< 0.028	0.64	< 0.028	0.040
CHRYSENE	< 0.028	< 0.028	0.26	< 0.028	< 0.028
PYRENE	< 0.028	< 0.028	0.44	< 0.028	0.043
PHENANTHRENE	< 0.055	< 0.055	0.27	< 0.055	0.12
ANTHRACENE	< 0.028	< 0.028	0.20	< 0.028	0.048
BENZO(A)ANTHRACENE	< 0.055	< 0.055	0.20	< 0.055	< 0.055
BENZO(B)FLUORANTHENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055

CAL

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
BENZO(K)FLUORANTHENE	< 0.055	< 0.055	0.52	< 0.055	< 0.055
BENZO(A)PYRENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
DIBENZO(A,H)ANTHRACENE	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083
BENZO(GHI)PERYLENE	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083
4-CHLOROPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
3,3'-DICHLOROBENZIDINE	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069
BENZIDINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-CHLOROETHYL) ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
1,2-DIPHENYLHYDRAZINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
HEXACHLOROCYCLOPENTADIENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODIPHENYLAMINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ACENAPHTHYLENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ACENAPHTHENE	< 0.028	< 0.028	< 0.028	< 0.028	0.044
BUTYL BENZYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODIMETHYLAMINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
N-NITROSODI-N-PROPYLAMINE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
BIS(2-CHLOROISOPROPYL) ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
DIETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

CAL

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
INDENO(1,2,3-CD)PYRENE	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069
NAPHTHALENE	0.20	< 0.028	< 0.028	< 0.025	0.56
ACID EXTRACTS-11 CPDS, GC					
PHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2-NITROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
4-NITROPHENOL	0.2	0.2	0.2	0.2	0.2
2,4-DINITROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
4,6-DINITRO-O-CRESOL	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
PENTACHLOROPHENOL	< 0.3	< 0.3	30	27	< 0.3
P-CHLORO-M-CRESOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2-CHLOROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2,4-DICHLOROPHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4,6-TRICHLOROPHENOL	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
2,4-DIMETHYLPHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PESTICIDES/PCB'S-26 CPDS, GC					
ALPHA ENDOSULFAN	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
BETA ENDOSULFAN	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064
ENDOSULFAN SULFATE	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066

CAL

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
BHC, ALPHA	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
BHC, BETA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
BHC, DELTA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
BHC, GAMMA	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ALDRIN	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
DIELDRIN	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
4,4'-DDE	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
4,4'-DDD	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
4,4'-DDT	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012
HEPTACHLOR	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009
HEPTACHLOR EPOXIDE	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
CHLORDANE	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
TOXAPHENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PCB-1016	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1221	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1232	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1242	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1248	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

CAL

LAB#	4090519	4090520	4090521	4090522	4090523
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET
PCB-1254	< 0.1	< 0.1	0.4	< 0.1	< 0.1
PCB-1260	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TETRACHLORODIBENZO-P-DIOXIN	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
ENDRIN	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ENDRIN ALDEHYDE	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023
THIRAM	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

CAL

KUMAR MALHOTRA
ASSOCIATES
ANALYTICAL REPORT
September 21, 1984

SOIL SAMPLES

CAL
Canton Analytical Laboratory, Inc.
P. O. Box 1129 ☐ 153 Elder Street
Ypsilanti, Michigan 48197
(313) 483-7430

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/21/84 PAGE 1

LAB# 4090698 B3 SURFACE
LAB# 4090699 B3 NEAR SURFACE
LAB# 4090700 B339.5 - 40 FEET
LAB# 4090701 B5 SPUN AUGERS & SAMPLE FROM 20 FEET
LAB# 4090702 B8 20 FEET OFF AUGERS
LAB# 4090703 B10 NEAR SURFACE

LAB#	4090698	4090699	4090700	4090701	4090702	4090703
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
ASBESTOS, % OF BULK SAMPLE	0	0	0	0	0	0
ALUMINUM, TOTAL	5500	3800	3000	1300	1600	2900
CHROMIUM, TOTAL	23	12	6.1	1.3	1.3	8.2
BARIUM, TOTAL	680	330	110	21	45	13
BERYLLIUM, TOTAL	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
COBALT, TOTAL	4.0	2.3	2.0	< 0.2	1.2	1.4
COPPER, TOTAL	880	2800	9.6	2.5	2.5	3.5
IRON, TOTAL	13000	83000	39000	5200	81000	4800
NICKEL, TOTAL	62	40	16	3.9	3.6	18
MANGANESE, TOTAL	450	270	320	110	140	140
ZINC, TOTAL	1800	2500	30	21	15	25
VANADIUM	18	14	13	6.0	7.4	21
SILVER, TOTAL	2.3	1.5	2.0	1.1	1.6	1.6

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/21/84

LAB#	4090698	4090699	4090700	4090701	4090702	409070
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG
ARSENIC, TOTAL	3.4	3.4	3.6	1.4	1.3	1.9
ANTIMONY, TOTAL	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
SELENIUM, TOTAL	0.10	0.18	< 0.04	< 0.04	< 0.04	0.0
THALLIUM, TOTAL	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40	< 0.4
MERCURY, TOTAL	0.10	0.17	0.05	0.04	0.02	0.0
TIN, TOTAL	< 20	25	25	< 20	< 20	< 20
CADMIUM, TOTAL	< 0.20	2.0	< 0.20	< 0.20	< 0.20	< 0.2
LEAD, TOTAL	4700	1300	13	8.2	5.4	20
BORON	9.7	19	3.3	1.7	3.0	5.7
NITROGEN, AMMONIA AS N	12	18	16	16	43	16
CYANIDE, TOTAL	2.3	< 0.1	1.6	0.8	< 0.10	< 0.1
SULFIDES, as S	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
PURGEABLES-31 CPDS, GC						
ACROLEIN	< 1	< 1	<1	< 1	<1	<1
ACRYLONITRILE	< 1	< 1	<1	< 1	<1	<1
BENZENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
TOLUENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
ETHYLBENZENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

CAL02

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/21/84

LAB#	4090698	4090699	4090700	4090701	4090702	409070
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG
CARBON TETRACHLORIDE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
CHLOROBENZENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
1,2-DICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,1-TRICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1-DICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2-TRICHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CHLOROETHANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
2-CHLOROETHYL VINYL ETHER	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
CHLOROFORM	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,2-DICHLOROPROPANE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CIS-1,3-DICHLOROPROPENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRANS-1,3-DICHLOROPROPENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
METHYLENE CHLORIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL CHLORIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
METHYL BROMIDE	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
BROMOFORM	< 1	< 1	< 1	< 1	< 1	< 1
DICHLOROBROMOMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8

CAL

LAB# / UNITS	4090698 MG/KG WET	4090699 MG/KG WET	4090700 MG/KG WET	4090701 MG/KG WET	4090702 MG/KG WET	40907 MG/KG
TRICHLOROFLUOROMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
DICHLORODIFLUOROMETHANE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
DIBROMOCHLOROMETHANE	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
TETRACHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TRICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
VINYL CHLORIDE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.2
TRANS-1,2-DICHLOROETHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
1,1,2,2-TETRACHLOROETHANE	< 0.2	<0.2	< 0.2	<0.2	<0.2	< 0.2
O-XYLENE	< 0.02	< 0. 02	< 0.02	< 0.02	< 0.02	< 0.02
XYLENES	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
BASE/NEUTRALS-46 CPDS, GC						
DI-N-BUTYLPHTHALATE	< 0.028	< 0.028	< 0.028	<0.028	< 0.028	< 0.02
1,2-DICHLOROBENZENE	< 0.028	< 0.028	<0.028	< 0.028	<0.028	<0.028
1,3-DICHLOROBENZENE	< 0.028	< 0.028	<0.028	< 0.028	<0.028	<0.028
1,4-DICHLOROBENZENE	< 0.028	< 0.028	<0.028	< 0.028	<0.028	<0.028
HEXACHLOROETHANE	< 0.028	0.68	<0.028	< 0.028	<0.028	<0.028
HEXACHLOROBUTADIENE	< 0.028	< 0.028	<0.028	< 0.028	<0.028	<0.028
HEXACHLOROBENZENE	< 0.028	< 0.028	<0.028	< 0.028	<0.028	<0.028

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/21/84

LAB#	4090698	4090699	4090700	4090701	4090702	409070
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG
1,2,4-TRICHLOROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
BIS(2-CHLOROETHOXY) METHANE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2-CHLORONAPHTHALENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
ISOPHORONE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055
NITROBENZENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
2,4-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
2,6-DINITROTOLUENE	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14	< 0.14
4-BROMOPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.029
BIS(2-ETHYLHEXYL) PHTHALATE	< 0.028	0.25	1.2	< 0.028	1.2	0.65
DI-N-OCTYL PHTHALATE	< 0.028	< 0.028	0.064	< 0.028	< 0.028	< 0.028
DIMETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
FLUORENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
FLUORANTHENE	0.088	<0.028	< 0.028	< 0.028	< 0.028	< 0.028
CHRYSENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
PYRENE	0.092	0.16	< 0.028	< 0.028	< 0.028	< 0.028
PHENANTHRENE	0.16	0.10	< 0.028	< 0.028	< 0.028	< 0.028
ANTHRACENE	0.040	0.084	< 0.028	0.032	< 0.028	< 0.028
BENZO(A)ANTHRACENE	0.045	0.074	< 0.028	< 0.028	< 0.028	CAL

LAB#	4090698	4090699	4090700	4090701	4090702	40907
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG
BENZO(B)FLUORANTHENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.05
BENZO(K)FLUORANTHENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	<<0.05
BENZO(A)PYRENE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.05
DIBENZO(A,H)ANTHRACENE	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	<<0.08
BENZO(GHI)PERYLENE	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	< 0.08
4-CHLOROPHENYLPHENYL ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
3,3'-DICHLOROBENZIDINE	< 0.069	< 0.069	< 0.069	< 0.069	< 0.069	< 0.06
BENZIDINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
BIS(2-CHLOROETHYL) ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
1,2-DIPHENYLHYDRAZINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
HEXACHLOROCYCLOPENTADIENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
N-NITROSODIPHENYLAMINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
ACENAPHTHYLENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
ACENAPHTHENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
BUTYL BENZYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
N-NITROSODIMETHYLAMINE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02
N-NITROSODI-N-PROPYLAMINE	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.05
BIS(2-CHLOROISOPROPYL) ETHER	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.02

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/21/84

LAB#	4090698	4090699	4090700	4090701	4090702	4090703
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
DIETHYL PHTHALATE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
INDENO(1,2,3-CD)PYRENE	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028
NAPHTHALENE	0.095	0.057	< 0.028	< 0.028	< 0.028	< 0.028
ACID EXTRACTS-11 CPDS, GC						
PHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2-NITROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
4-NITROPHENOL	< 0.2	< 0.2	< 0.2	< 0.2	<0.2	< 0.2
2,4-DINITROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
4,6-DINITRO-O-CRESOL	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
PENTACHLOROPHENOL	6.5	< 0.3	< 0.3	12	19	7.9
P-CHLORO-M-CRESOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2-CHLOROPHENOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
2,4-DICHLOROPHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4,6-TRICHLOROPHENOL	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
2,4-DIMETHYLPHENOL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PESTICIDES/PCB'S-26 CPDS, GC						
ALPHA ENDOSULFAN	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
BETA ENDOSULFAN	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064

CAL

LAB#	4090698	4090699	4090700	4090701	4090702	40907(
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG
ENDOSULFAN SULFATE	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066	< 0.0(
BHC, ALPHA	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.0(
BHC, BETA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0(
BHC, DELTA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0(
BHC, GAMMA	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.0(
ALDRIN	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0(
DIELDRIN	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0(
4,4'-DDE	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0(
4,4'-DDD	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	< 0.01
4,4'-DDT	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.01
HEPTACHLOR	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 0.00
HEPTACHLOR EPOXIDE	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
CHLORDANE	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.01
TOXAPHENE	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
PCB-1016	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1221	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1232	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1242	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	

CAL

LAB#	4090698	4090699	4090700	4090701	4090702	4090703
UNITS	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG WET	MG/KG W
PCB-1248	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1254	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
PCB-1260	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TETRACHLORODIBENZO-P-DIOXIN	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
ENDRIN	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
ENDRIN ALDEHYDE	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023	< 0.023
THIRAM	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028	< 0.028

CAL

SAMPLES RECEIVED 09/21/84

LAB# 4090704 B10 AT 20 FEET
LAB# 4090705 B10 FIELD BLANK

LAB# / UNITS	4090704 MG/KG WET	4090705 MG/KG WET
ASBESTOS, % OF BULK SAMPLE	0	0
ALUMINUM, TOTAL	4500	53
CHROMIUM, TOTAL	4.8	1.2
BARIUM, TOTAL	170	2.8
BERYLLIUM, TOTAL	< 0.2	< 0.2
COBALT, TOTAL	2.7	< 0.2
COPPER, TOTAL	12	13
IRON, TOTAL	11000	100
NICKEL, TOTAL	17	< 0.4
MANGANESE, TOTAL	410	0.8
ZINC, TOTAL	28	2.2
VANADIUM	22	22
SILVER, TOTAL	3.2	< 0.2
ARSENIC, TOTAL	4.1	0.86
ANTIMONY, TOTAL	< 0.3	< 0.3

CAL

LAB#	4090704	4090705
UNITS	MG/KG WET	MG/KG WET
SELENIUM, TOTAL	0.06	< 0.04
THALLIUM, TOTAL	< 0.40	< 0.40
MERCURY, TOTAL	< 0.02	< 0.02
TIN, TOTAL	33	< 20
CADMIUM, TOTAL	< 0.20	< 0.20
LEAD, TOTAL	9.6	< 1.0
BORON	1.8	2.3
NITROGEN, AMMONIA AS N	21	< 10
CYANIDE, TOTAL	< 0.10	4.4
SULFIDES, as S	< 0.5	< 0.5
PURGEABLES-31 CPDS, GC		
ACROLEIN	< 1	< 1
ACRYLONITRILE	< 1	< 1
BENZENE	< 0.02	< 0.02
TOLUENE	< 0.02	< 0.02
ETHYLBENZENE	< 0.02	< 0.02
CARBON TETRACHLORIDE	< 0.8	< 0.8
CHLOROBENZENE	< 0.02	< 0.02

CAL

SAMPLES RECEIVED 09/21/84

LAB#	4090704	4090705
UNITS	MG/KG WET	MG/KG WET
1,2-DICHLOROETHANE	< 0.2	< 0.2
1,1,1-TRICHLOROETHANE	< 0.2	< 0.2
1,1-DICHLOROETHANE	< 0.2	< 0.2
1,1-DICHLOROETHENE	< 0.2	< 0.2
1,1,2-TRICHLOROETHANE	< 0.2	< 0.2
CHLOROETHANE	< 0.2	< 0.2
2-CHLOROETHYL VINYL ETHER	< 0.5	< 0.5
CHLOROFORM	< 0.4	< 0.4
1,2-DICHLOROPROPANE	< 0.2	< 0.2
CIS-1,3-DICHLOROPROPENE	< 0.2	< 0.2
TRANS-1,3-DICHLOROPROPENE	< 0.2	< 0.2
METHYLENE CHLORIDE	< 0.4	< 0.4
METHYL CHLORIDE	< 0.4	< 0.4
METHYL BROMIDE	< 0.4	< 0.4
BROMOFORM	< 1	< 1
DICHLOROBROMOMETHANE	< 0.8	< 0.8
TRICHLOROFLUOROMETHANE	< 0.8	< 0.8
DICHLORODIFLUOROMETHANE	< 0.1	< 0.1

CAL

LAB#	4090704	4090705
UNITS	MG/KG WET	MG/KG WET
DIBROMOCHLOROMETHANE	< 0.5	< 0.5
TETRACHLOROETHENE	< 0.2	< 0.2
TRICHLOROETHENE	< 0.2	< 0.2
VINYL CHLORIDE	< 0.5	< 0.5
TRANS-1,2-DICHLOROETHENE	< 0.2	< 0.2
1,1,2,2-TETRACHLOROETHANE	<0.2	< 0.2
O-XYLENE	<0.02	< 0.02
XYLENES	<0.02	< 0.02
BASE/NEUTRALS- 46 CPDS, GC		
DI-N-BUTYL PHTHALATE	< 0.028	< 0.028
1,2-DICHLOROBENZENE	< 0.028	< 0.028
1,3-DICHLOROBENZENE	< 0.028	< 0.028
1,4-DICHLOROBENZENE	< 0.028	< 0.028
HEXACHLOROETHANE	< 0.028	< 0.028
HEXACHLOROBUTADIENE	< 0.028	< 0.028
HEXACHLOROBENZENE	< 0.028	< 0.028
1,2,4-TRICHLOROBENZENE	< 0.028	< 0.028
BIS(2-CHLOROETHOXY) METHANE	< 0.028	< 0.028

CAL

LAB#	4090704	4090705
UNITS	MG/KG WET	MG/KG WET
2-CHLORONAPHTHALENE	< 0.028	< 0.028
ISOPHORONE	< 0.055	< 0.055
NITROBENZENE	< 0.028	< 0.028
2,4-DINITROTOLUENE	< 0.14	< 0.14
2,6-DINITROTOLUENE	< 0.14	< 0.14
4-BROMOPHENYLPHENYL ETHER	< 0.028	< 0.028
BIS(2-ETHYLHEXYL) PHTHALATE	1.3	3.1
DI-N-OCTYL PHTHALATE	< 0.028	1.0
DIMETHYL PHTHALATE	< 0.028	< 0.028
FLUORENE	< 0.028	< 0.028
FLUORANTHENE	< 0.088	< 0.088
CHRYSENE	< 0.028	< 0.028
PYRENE	< 0.028	< 0.028
PHENANTHRENE	< 0.028	< 0.028
ANTHRACENE	< 0.028	< 0.028
BENZO(A)ANTHRACENE	< 0.028	< 0.028
BENZO(B)FLUORANTHENE	< 0.055	< 0.055
BENZO(K)FLUORANTHENE	< 0.055	< 0.055

CAL

LAB#	4090704	4090705
UNITS	MG/KG WET	MG/KG WET
BENZO(A)PYRENE	< 0.055	< 0.055
DIBENZO(A,H)ANTHRACENE	< 0.083	< 0.083
BENZO(GHI)PERYLENE	< 0.083	< 0.083
4-CHLOROPHENYLPHENYL ETHER	< 0.038	< 0.038
3,3'-DICHLOROBENZIDINE	< 0.069	< 0.069
BENZIDINE	< 0.028	< 0.028
BIS(2-CHLOROETHYL) ETHER	< 0.028	< 0.028
1,2-DIPHENYLHYDRAZINE	< 0.028	< 0.028
HEXACHLOROCYCLOPENTADIENE	< 0.028	< 0.028
N-NITROSODIPHENYLAMINE	< 0.028	< 0.028
ACENAPHTHYLENE	< 0.028	< 0.028
ACENAPHTHENE	< 0.028	< 0.028
BUTYL BENZYL PHTHALATE	< 0.028	< 0.028
N-NITROSODIMETHYLAMINE	< 0.028	< 0.028
N-NITROSODI-N-PROPYLAMINE	< 0.055	< 0.055
BIS(2-CHLOROISOPROPYL) ETHER	< 0.028	< 0.028
DIETHYL PHTHALATE	< 0.028	< 0.028
INDENO(1,2,3-CD)PYRENE	< 0.028	< 0.028

CAL

SAMPLES RECEIVED 09/21/84

LAB#	4090704	4090705
UNITS	MG/KG WET	MG/KG WET
NAPHTHALENE	< 0.028	< 0.028
ACID EXTRACTS-11 CPDS, GC		
PHENOL	< 0.01	< 0.01
2-NITROPHENOL	< 0.02	< 0.02
4-NITROPHENOL	< 0.2	< 0.2
2,4-DINITROPHENOL	< 0.02	< 0.02
4,6-DINITRO-O-CRESOL	< 0.6	< 0.6
PENTACHLOROPHENOL	< 0.3	< 0.3
P-CHLORO-M-CRESOL	< 0.02	< 0.02
2-CHLOROPHENOL	< 0.02	< 0.02
2,4-DICHLOROPHENOL	< 0.01	< 0.01
2,4,6-TRICHLOROPHENOL	< 0.03	< 0.03
2,4-DIMETHYLPHENOL	< 0.01	< 0.01
PESTICIDES/PCB'S-26 CPDS, GC		
ALPHA ENDOSULFAN	< 0.014	< 0.014
BETA ENDOSULFAN	< 0.064	< 0.064
ENDOSULFAN SULFATE	< 0.066	< 0.066
BHC, ALPHA	< 0.003	< 0.003

CAL

LAB#		4090704	4090705
UNITS		MG/KG WET	MG/KG WET
BHC, BETA		< 0.004	< 0.004
BHC, DELTA		< 0.004	< 0.004
BHC, GAMMA		< 0.006	< 0.006
ALDRIN		< 0.004	< 0.004
DIELDRIN		< 0.002	< 0.002
4,4'-DDE		< 0.004	< 0.004
4,4'-DDD		< 0.011	< 0.011
4,4'-DDT		< 0.012	< 0.012
HEPTACHLOR		< 0.009	< 0.009
HEPTACHLOR EPOXIDE		< 0.08	< 0.08
CHLORDANE		< 0.014	< 0.014
TOXAPHENE		< 0.02	< 0.02
PCB-1016		< 0.1	< 0.1
PCB-1221		< 0.1	< 0.1
PCB-1232		< 0.1	< 0.1
PCB-1242		< 0.1	< 0.1
PCB-1248		< 0.1	< 0.1
PCB-1254		< 0.1	< 0.1

CAL

LAB#		4090704	4090705
UNITS		MG/KG WET	MG/KG WET
PCB-1260		< 0.1	< 0.1
TETRACHLORODIBENZO-P-DIOXIN		< 0.02	< 0.02
ENDRIN		< 0.006	< 0.006
ENDRIN ALDEHYDE		< 0.023	< 0.023
THIRAM		< 0.018	< 0.018

CA

KUMAR MALHOTRA
ASSOCIATES
ANALYTICAL REPORT

ADDITIONAL SOIL BLANKS NOT STORED IN PLASTIC CONTAINER

CAL
Canton Analytical Laboratory, Inc.
P. O. Box 1129 ☐ 153 Elder Street
Ypsilanti, Michigan 48197
(313) 483-7430

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 10/08/84 PAGE 1

LAB# 4100336 SOIL BLANK

LAB#	4100336
UNITS	MG/KG WET
ASBESTOS, % OF BULK SAMPLE	0
ALUMINUM, TOTAL	14
CHROMIUM, TOTAL	3.6
BARIUM, TOTAL	10
BERYLLIUM, TOTAL	<0.2
COBALT, TOTAL	0.15
COPPER, TOTAL	1.2
IRON, TOTAL	73
NICKEL, TOTAL	0.71
MANGANESE, TOTAL	1.1
ZINC, TOTAL	1.4
VANADIUM	<10
SILVER, TOTAL	1.0
ARSENIC, TOTAL	0.71
ANTIMONY, TOTAL	<0.07
SELENIUM, TOTAL	<0.02

CAL

LAB#	4100336
UNITS	MG/KG WET
THALLIUM, TOTAL	<0.4
MERCURY, TOTAL	<0.01
TIN, TOTAL	<20
CADMIUM, TOTAL	0.20
LEAD, TOTAL	<1.0
BORON	4.1
NITROGEN, AMMONIA AS N	<10
CYANIDE, TOTAL	<0.1
SULFIDES, as S	<0.5
PURGEABLES-31 CPDS, GC	
ACROLEIN	<1
ACRYLONITRILE	<1
BENZENE	< 0.02
TOLUENE	< 0.02
ETHYLBENZENE	< 0.02
CARBON TETRACHLORIDE	< 0.8
CHLOROBENZENE	< 0.02
1,2-DICHLOROETHANE	< 0.2

CAL

LAB#	4100336
UNITS	MG/KG WET
1,1,1-TRICHLOROETHANE	< 0.2
1,1-DICHLOROETHANE	< 0.2
1,1-DICHLOROETHENE	< 0.2
1,1,2-TRICHLOROETHANE	< 0.2
CHLOROETHANE	< 0.2
2-CHLOROETHYL VINYL ETHER	< 0.5
CHLOROFORM	< 0.4
1,2-DICHLOROPROPANE	< 0.2
CIS-1,3-DICHLOROPROPENE	< 0.2
TRANS-1,3-DICHLOROPROPENE	< 0.2
METHYLENE CHLORIDE	< 0.4
METHYL CHLORIDE	< 0.5
METHYL BROMIDE	< 0.8
BROMOFORM	< 1
DICHLOROBROMOMETHANE	< 0.8
TRICHLOROFLUOROMETHANE	< 0.8
DICHLORODIFLUOROMETHANE	< 0.8
DIBROMOCHLOROMETHANE	< 0.8

CAL

LAB#	4100336
UNITS	MG/KG WET
TETRACHLOROETHENE	< 0.2
TRICHLOROETHENE	< 0.2
VINYL CHLORIDE	< 0.5
TRANS-1,2-DICHLOROETHENE	< 0.2
1,1,1,2-TETRACHLOROETHANE	< 0.2
XYLENES	< 0.02
BASE/NEUTRALS	
BIS(2-ETHYLHEXYL) PHTHALATE	1.1
THIRAM	< 0.181
1,2-DICHLOROBENZENE	< 0.181
1,3-DICHLOROBENZENE	< 0.181
1,4-DICHLOROBENZENE	< 0.181
HEXACHLOROETHANE	< 0.181
HEXACHLOROBUTADIENE	< 0.181
HEXACHLOROBENZENE	< 0.181
1,2,4-TRICHLOROBENZENE	< 0.181

CAL

LAB#	4100336
UNITS	MG/KG WET
BIS(2-CHLOROETHOXY) METHANE	< 0.181
2-CHLORONAPHTHALENE	< 0.181
ISOPHORONE	< 0.362
NITROBENZENE	< 0.181
2,4-DINITROTOLUENE	< 0.906
2,6-DINITROTOLUENE	< 0.906
4-BROMOPHENYLPHENYL ETHER	< 0.181
DI-N-BUTYL PHTHALATE	< 0.181
DI-N-OCTYL PHTHALATE	< 0.181
DIMETHYL PHTHALATE	< 0.181
FLUORENE	< 0.181
FLUORANTHENE	< 0.181
CHRYSENE	< 0.181
PYRENE	< 0.181
PHENANTHRENE	< 0.181
ANTHRACENE	< 0.181
BENZO(A)ANTHRACENE	< 0.181
BENZO(B)FLUORANTHENE	< 0.362

CAL

LAB#	4100336
UNITS	MG/KG WET
BENZO(K)FLUORANTHENE	< 0.181
BENZO(A)PYRENE	< 0.362
DIBENZO(A,H)ANTHRACENE	< 0.544
BENZO(GHI)PERYLENE	< 0.544
4-CHLOROPHENYLPHENYL ETHER	< 0.181
3,3'-DICHLOROBENZIDINE	< 0.453
BENZIDINE	< 0.181
BIS(2-CHLOROETHYL) ETHER	< 0.181
1,2-DIPHENYLHYDRAZINE	< 0.181
HEXACHLOROCYCLOPENTADIENE	< 0.181
N-NITROSODIPHENYLAMINE	< 0.362
ACENAPHTHYLENE	< 0.181
ACENAPHTHENE	< 0.181
BUTYL BENZYL PHTHALATE	< 0.181
N-NITROSODIMETHYLAMINE	< 0.181
N-NITROSODI-N-PROPYLAMINE	< 0.362
BIS(2-CHLOROISOPROPYL) ETHER	< 0.181
DIETHYL PHTHALATE	< 0.181

CA

SAMPLES RECEIVED 10/08/84

LAB#	4100336
UNITS	MG/KG WET
INDENO(1,2,3-CD)PYRENE	< 0.453
NAPHTHALENE	< 0.181
ACID EXTRACTS-11 CPDS, GC	
PHENOL	< 0.01
2-NITROPHENOL	< 0.02
4-NITROPHENOL	< 0.2
2,4-DINITROPHENOL	< 0.01
4,6-DINITRO-O-CRESOL	< 0.03
PENTACHLOROPHENOL	< 0.3
P-CHLORO-M-CRESOL	< 0,02
2-CHLOROPHENOL	< 0.02
2,4-DICHLOROPHENOL	< 0.01
2,4,6-TRICHLOROPHENOL	< 0.03
2,4-DIMETHYLPHENOL	< 0.01
PESTICIDES/PCB'S-26 CPDS, GC	
ALPHA ENDOSULFAN	< 0.014
BETA ENDOSULFAN	< 0.064
ENDOSULFAN SULFATE	< 0.066

SAMPLES RECEIVED 10/08/84

LAB#	4100336
UNITS	MG/KG WET
BHC, ALPHA	< 0.003
BHC, BETA	< 0.004
BHC, DELTA	< 0.004
BHC, GAMMA	< 0.006
ALDRIN	< 0.004
DIELDRIN	< 0.002
4,4'-DDE	< 0.004
4,4'-DDD	< 0.011
4,4'-DDT	< 0.012
HEPTACHLOR	< 0.009
HEPTACHLOR EPOXIDE	< 0.08
CHLORDANE	< 0.014
TOXAPHENE	< 0.02
PCB-1016	< 0.25
PCB-1221	< 0.25
PCB-1232	< 0.25
PCB-1242	< 0.25
PCB-1248	< 0.25

CA

SAMPLES RECEIVED 10/08/84

LAB#	4100336
UNITS	MG/KG WET
PCB-1254	< 0.25
PCB-1260	< 0.25
ENDRIN ALDEHYDE	< 0.023
ENDRIN	< 0.006
TETRACHLORODIBENZO-P-DIOXIN	< 0.02

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 12/07/84 : PAGE 1

LAB# 4120142 BLANK SOIL

LAB#	4120142
UNITS	MG/KGM
BASE/NEUTRALS-46 CPDS, GC	
1,2-DICHLOROBENZENE	<0.02
1,3-DICHLOROBENZENE	<0.02
1,4-DICHLOROBENZENE	<0.02
HEXACHLOROETHANE	<0.02
HEXACHLOROBUTADIENE	<0.02
HEXACHLOROBENZENE	<0.02
1,2,4-TRICHLOROBENZENE	<0.02
BIS(2-CHLOROETHOXY) METHANE	<0.02
2-CHLORONAPHTHALENE	<0.02
ISOPHORONE	<0.02
NITROBENZENE	<0.02
2,4-DINITROTOLUENE	<0.02
2,6-DINITROTOLUENE	<0.02
4-BROMOPHENYLPHENYL ETHER	<0.02
BIS(2-ETHYLHEXYL) PHTHALATE	<0.02

LAB#	4120142
UNITS	MG/KGM
DI-N-OCTYL PHTHALATE	2.2
DIMETHYL PHTHALATE	0.20
FLUORENE	<0.02
FLUORANTHENE	<0.02
CHRYSENE	<0.02
PYRENE	<0.02
PHENANTHRENE	<0.02
ANTHRACENE	<0.02
BENZO(A)ANTHRACENE	<0.02
BENZO(B)FLUORANTHENE	<0.02
BENZO(K)FLUORANTHENE	<0.02
BENZO(A)PYRENE	<0.02
DIBENZO(A,H)ANTHRACENE	<0.02
BENZO(GHI)PERYLENE	<0.02
4-CHLOROPHENYLPHENYL ETHER	<0.02
3,3'-DICHLOROBENZIDINE	<0.2
BENZIDINE	<0.2
BIS(2-CHLOROETHYL) ETHER	<0.02

LAB#	4120142
UNITS	MG/KGM
1,2-DIPHENYLHYDRAZINE	<0.02
HEXACHLOROCYCLOPENTADIENE	<0.02
N-NITROSODIPHENYLAMINE	<0.02
ACENAPHTHYLENE	<0.06
ACENAPHTHENE	<0.04
BUTYL BENZYL PHTHALATE	<0.02
N-NITROSODIMETHYLAMINE	<0.02
N-NITROSODI-N-PROPYLAMINE	<0.02
BIS(2-CHLOROISOPROPYL) ETHER	<0.02
DIETHYL PHTHALATE	<0.02
INDENO(1,2,3-CD)PYRENE	<0.02
NAPHTHALENE	<0.04

CAT

KUMAR MALHOTRA
ASSOCIATES
ANALYTICAL REPORT

GROUNDWATER SAMPLES

CAL

Canton Analytical Laboratory, Inc.
P. O. Box 1129 ☐ 153 Elder Street
Ypsilanti, Michigan 48197
(313) 483-7430

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB# 4090939 WELL #1 9-26-84
LAB# 4090940 WELL #2 9-27-84
LAB# 4090941 WELL #3 9-27-84
LAB# 4090942 WELL #3 9-27-84
LAB# 4090943 WELL #4 9-27-84
LAB# 4090944 WELL #5 9-27-84

LAB# / UNITS	4090939 MG/L	4090940 MG/L	4090941 MG/L	4090942 MG/L	4090943 MG/L	40909? MG/L
ASBESTOS, FIBERS/LITER	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
ALUMINUM, TOTAL	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
CHROMIUM, TOTAL	< 0.010	< 0.010	0.011	< 0.010	< 0.010	< 0.010
BARIUM, TOTAL	0.35	0.38	0.21	0.19	0.18	0.16
BERYLLIUM, TOTAL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
COBALT, TOTAL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
COPPER, TOTAL	0.02	0.03	0.02	< 0.01	< 0.01	0.07
IRON, TOTAL	< 0.02	0.86	0.13	0.12	0.08	1.6
NICKEL, TOTAL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
MANGANESE, TOTAL	0.15	0.20	0.09	0.09	0.02	0.21
ZINC, TOTAL	0.01	0.03	< 0.01	0.01	< 0.01	0.24
VANADIUM	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
SILVER, TOTAL	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

N.D. =Not Detected <50 fibers/ml

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090939	4090940	4090941	4090942	4090943	4090944
UNITS	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
ARSENIC, TOTAL	0.029	0.022	0.020	0.023	0.021	< 0.002
ANTIMONY, TOTAL	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
SELENIUM, TOTAL	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
THALLIUM, TOTAL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
MERCURY, TOTAL	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
TIN, TOTAL	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
CADMIUM, TOTAL	< 0.0010	< 0.0010	0.0011	< 0.0010	< 0.0010	0.0011
LEAD, TOTAL	0.014	< 0.005	< 0.005	< 0.005	< 0.005	0.006
BORON	0.97	0.71	0.41	0.34	0.35	0.28
NITROGEN, AMMONIA AS N	2.3	0.9	1.6	1.6	0.6	1.6
CYANIDE, TOTAL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
SULFIDES, as S	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TOTAL ORGANIC CARBON	7.2	6.8	3.1	3.1	3.5	2.8
O-XYLENE	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
PURGEABLES-31 CPDS, GC						
ACROLEIN	< 0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ACRYLONITRILE	< 0.005	<0.005	<0.005	<0.005	<0.005	<0.005
BENZENE	< 0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

CAL

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090939	4090940	4090941	4090942	4090943	409094
UNITS	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
TOLUENE	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
ETHYLBENZENE	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
CARBON TETRACHLORIDE	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
CHLOROBENZENE	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
1,2-DICHLOROETHANE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
1,1,1-TRICHLOROETHANE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
1,1-DICHLOROETHANE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.002
1,1-DICHLOROETHENE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
1,1,2-TRICHLOROETHANE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
CHLOROETHANE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
2-CHLOROETHYL VINYL ETHER	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
CHLOROFORM	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
1,2-DICHLOROPROPANE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
CIS-1,3-DICHLOROPROPENE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
TRANS-1,3-DICHLOROPROPENE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
METHYLENE CHLORIDE	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
METHYL CHLORIDE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
METHYL BROMIDE	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008

CAT

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090939	4090940	4090941	4090942	4090943	409
UNITS	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
BROMOFORM	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
DICHLORODBROMOMETHANE	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.0(
TRICHLOROFLUOROMETHANE	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.0(
DICHLORODIFLUOROMETHANE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
DIBROMOCHLOROMETHANE	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.0(
TETRACHLOROETHENE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0(
TRICHLOROETHENE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0(
VINYL CHLORIDE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0(
TRANS-1,2-DICHLOROETHENE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0(
1,1,2,2-TETRACHLOROETHANE	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0(
XYLENES	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0(
THIRAM	< 0.00 5	< 0.00 5	< 0.005	< 0.005	< 0.005	< 0.0
TETRACHLORODIBENZO-P-DIOXIN	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0
BASE/NEUTRALS-46 CPDS, GC						
1,2-DICHLOROBENZENE	<0.005	<0.005	< 0.005	< 0.005	< 0.005	< 0.(
1,3-DICHLOROBENZENE	<0.005	<0.005	< 0.005	< 0.005	< 0.005	< 0.(
1,4-DICHLOROBENZENE	<0.005	<0.005	< 0.005	< 0.005	< 0.005	< 0.(

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090939	4090940	4090941	4090942	4090943	40909
UNITS	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
HEXACHLOROETHANE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
HEXACHLOROBUTADIENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
HEXACHLOROBENZENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
1,2,4-TRICHLOROBENZENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
BIS(2-CHLOROETHOXY) METHANE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
2-CHLORONAPHTHALENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
ISOPHORONE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
NITROBENZENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
2,4-DINITROTOLUENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
2,6-DINITROTOLUENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
4-BROMOPHENYLPHENYL ETHER	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
BIS(2-ETHYLHEXYL) PHTHALATE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
DI-N-OCTYL PHTHALATE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
DIMETHYL PHTHALATE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
FLUORENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
FLUORANTHENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
CHRYSENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
PYRENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090939	4090940	4090941	4090942	4090943	40909
UNITS	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
PHENANTHRENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
ANTHRACENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
BENZO(A)ANTHRACENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
BENZO(B)FLUORANTHENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00
BENZO(K)FLUORANTHENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
BENZO(A)PYRENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
DIBENZO(A,H)ANTHRACENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
BENZO(GHI)PERYLENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
4-CHLOROPHENYLPHENYL ETHER	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
3,3'-DICHLOROBENZIDINE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
BENZIDINE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
BIS(2-CHLOROETHYL) ETHER	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
BUTYL BENZYL PHTHALATE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
HEXACHLOROCYCLOPENTADIENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
N-NITROSODIPHENYLAMINE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
ACENAPHTHYLENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
ACENAPHTHENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090939	4090940	4090941	4090942	4090943	409
UNITS	MG/L	MG/L	MG/L	MG/L	MG/L	MG/
N-NITROSODIMETHYLAMINE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.
N-NITROSODI-N-PROPYLAMINE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.
BIS(2-CHLOROISOPROPYL) ETHER	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.
DIETHYL PHTHALATE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.
INDENO(1,2,3-CD)PYRENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.
NAPHTHALENE	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.
ACID EXTRACTS-11 CPDS, GC						
PHENOL	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.
2-NITROPHENOL	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.
4-NITROPHENOL	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.
2,4-DINITROPHENOL	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.
4,6-DINITRO-O-CRESOL	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.
PENTACHLOROPHENOL	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.
P-CHLORO-M-CRESOL	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.
2-CHLOROPHENOL	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.
2,4-DICHLOROPHENOL	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.
2,4,6-TRICHLOROPHENOL	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.
2,4-DIMETHYLPHENOL	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.0004	< 0.

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090939	4090940	4090941	4090942	4090943	4090
UNITS	UG/L	UG/L	UG/L	UG/L	UG/L	UG
PESTICIDES/PCB'S-26 CPDS, GC						
ALPHA ENDOSULFAN	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.0
BETA ENDOSULFAN	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064	< 0.0
ENDOSULFAN SULFATE	< 0.066	< 0.066	< 0.066	< 0.066	< 0.066	< 0.0
BHC, ALPHA	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.0
BHC, BETA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0
BHC, DELTA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0
BHC, GAMMA	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0
ALDRIN	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0
DIELDRIN	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0
4,4'-DDE	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0
4,4'-DDD	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011	< 0.0
4,4'-DDT	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.0
HEPTACHLOR	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.0
HEPTACHLOR EPOXIDE	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.0
CHLORDANE	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.0
TOXAPHENE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PCB-1016	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.2

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090939	4090940	4090941	4090942	4090943	409
UNITS	UG/L	UG/L	UG/L	UG/L	UG/L	UG/
PCB-1221	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.
PCB-1232	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.
PCB-1242	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.
PCB-1248	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.
PCB-1254	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.
PCB-1260	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.
ENDRIN	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0
ENDRIN ALDEHYDE	< 0.023	< 0.023	< 0.023	< 0.023	< 0.032	< 0

LAB# 4090945 F-BLANK 9-26

LAB#	4090945
UNITS	MG/L
ASBESTOS, FIBERS/LITER	N.D.
ALUMINUM, TOTAL	< 0.10
CHROMIUM, TOTAL	< 0.010
BARIUM, TOTAL	< 0.10
BERYLLIUM, TOTAL	< 0.01
COBALT, TOTAL	< 0.01
COPPER, TOTAL	0.07
IRON, TOTAL	< 0.02
NICKEL, TOTAL	< 0.02
MANGANESE, TOTAL	< 0.01
ZINC, TOTAL	0.06
VANADIUM	< 0.10
SILVER, TOTAL	< 0.01
ARSENIC, TOTAL	< 0.002
ANTIMONY, TOTAL	< 0.002
SELENIUM, TOTAL	< 0.001

LAB#	4090945
UNITS	MG/L
THALLIUM, TOTAL	< 0.02
MERCURY, TOTAL	< 0.0005
TIN, TOTAL	< 1.0
CADMIUM, TOTAL	< 0.0010
LEAD, TOTAL	< 0.005
BORON	0.47
NITROGEN, AMMONIA AS N	< 0.1
CYANIDE, TOTAL	< 0.02
SULFIDES, as S	< 0.1
TOTAL ORGANIC CARBON	110
O-XYLENE	0.0002
PURGEABLES-31 CPDS, GC	
ACROLEIN	< 0.005
ACRYLONITRILE	< 0.005
BENZENE	< 0.0002
TOLUENE	< 0.0002
ETHYLBENZENE	< 0.0002
CARBON TETRACHLORIDE	< 0.008

KUMAR MALHOTRA ASSOCIATES

SAMPLES RECEIVED 09/28/84

LAB#	4090945
UNITS	MG/L
CHLOROBENZENE	< 0.0002
1,2-DICHLOROETHANE	< 0.002
1,1,1-TRICHLOROETHANE	< 0.002
1,1-DICHLOROETHANE	< 0.002
1,1-DICHLOROETHENE	< 0.002
1,1,2-TRICHLOROETHANE	< 0.002
CHLOROETHANE	< 0.002
2-CHLOROETHYL VINYL ETHER	< 0.005
CHLOROFORM	< 0.004
1,2-DICHLOROPROPANE	< 0.002
CIS-1,3-DICHLOROPROPENE	< 0.002
TRANS-1,3-DICHLOROPROPENE	< 0.002
METHYLENE CHLORIDE	< 0.004
METHYL CHLORIDE	< 0.005
METHYL BROMIDE	< 0.008
BROMOFORM	< 0.01
DICHLOROBROMOMETHANE	< 0.008
TRICHLOROFLUOROMETHANE	< 0.008

LAB#	4090945
UNITS	MG/L
DICHLORODIFLUOROMETHANE	< 0.01
DIBROMOCHLOROMETHANE	< 0.008
TETRACHLOROETHENE	< 0.002
TRICHLOROETHENE	< 0.002
VINYL CHLORIDE	< 0.005
TRANS-1,2-DICHLOROETHENE	< 0.002
1,1,2,2-TETRACHLOROETHANE	< 0.002
XYLENES	< 0.0002
THIRAM	< 0.005
TETRACHLORODIBENZO-P-DIOXIN	< 0.005
BASE/NEUTRALS-46 CPDS, GC	
1,2-DICHLOROBENZENE	< 0.005
1,3-DICHLOROBENZENE	< 0.005
1,4-DICHLOROBENZENE	< 0.005
HEXACHLOROETHANE	< 0.005
HEXACHLOROBUTADIENE	< 0.005
HEXACHLOROBENZENE	< 0.005

LAB#	4090945
UNITS	MG/L
1,2,4-TRICHLOROBENZENE	< 0.005
BIS(2-CHLOROETHOXY) METHANE	< 0.005
2-CHLORONAPHTHALENE	< 0.005
ISOPHORONE	< 0.005
NITROBENZENE	< 0.005
2,4-DINITROTOLUENE	< 0.005
2,6-DINITROTOLUENE	< 0.005
4-BROMOPHENYLPHENYL ETHER	< 0.005
BIS(2-ETHYLHEXYL) PHTHALATE	< 0.005
DI-N-OCTYL PHTHALATE	< 0.005
DIMETHYL PHTHALATE	< 0.005
FLUORENE	< 0.005
FLUORANTHENE	< 0.005
CHRYSENE	< 0.005
PYRENE	< 0.005
PHENANTHRENE	< 0.005
ANTHRACENE	< 0.005
BENZO(A)ANTHRACENE	< 0.005

LAB#	4090945
UNITS	MG/L
BENZO(B)FLUORANTHENE	< 0.005
BENZO(K)FLUORANTHENE	< 0.005
BENZO(A)PYRENE	< 0.005
DIBENZO(A,H)ANTHRACENE	< 0.005
BENZO(GHI)PERYLENE	< 0.005
4-CHLOROPHENYLPHENYL ETHER	< 0.005
3,3'-DICHLOROBENZIDINE	< 0.01
BENZIDINE	< 0.01
BIS(2-CHLOROETHYL) ETHER	< 0.005
1,2-DIPHENYLHYDRAZINE	< 0.005
HEXACHLOROCYCLOPENTADIENE	< 0.005
N-NITROSODIPHENYLAMINE	< 0.005
ACENAPHTHYLENE	< 0.005
ACENAPHTHENE	< 0.005
BUTYL BENZYL PHTHALATE	< 0.005
N-NITROSODIMETHYLAMINE	< 0.005
N-NITROSODI-N-PROPYLAMINE	< 0.005
BIS(2-CHLOROISOPROPYL) ETHER	< 0.005

LAB#	4090945
UNITS	MG/L
DIETHYL PHTHALATE	< 0.005
INDENO(1,2,3-CD)PYRENE	< 0.005
NAPHTHALENE	< 0.005
ACID EXTRACTS-11 CPDS, GC	
PHENOL	< 0.0002
2-NITROPHENOL	< 0.0005
4-NITROPHENOL	< 0.003
2,4-DINITROPHENOL	< 0.015
4,6-DINITRO-O-CRESOL	< 0.02
PENTACHLOROPHENOL	< 0.007
P-CHLORO-M-CRESOL	< 0.0004
2-CHLOROPHENOL	< 0.0005
2,4-DICHLOROPHENOL	< 0.003
2,4,6-TRICHLOROPHENOL	< 0.0006
2,4-DIMETHYLPHENOL	< 0.0004
PESTICIDES/PCB'S-26 CPDS, GC	UG/L
ALPHA ENDOSULFAN	< 0.014
BETA ENDOSULFAN	< 0.064

LAB#	4090945
UNITS	UG/L
ENDOSULFAN SULFATE	< 0.066
BHC, ALPHA	< 0.003
BHC, BETA	< 0.004
BHC, DELTA	< 0.004
BHC, GAMMA	< 0.004
ALDRIN	< 0.004
DIELDRIN	< 0.002
4,4'-DDE	< 0.004
4,4'-DDD	< 0.011
4,4'-DDT	< 0.012
HEPTACHLOR	< 0.003
HEPTACHLOR EPOXIDE	< 0.08
CHLORDANE	< 0.014
TOXAPHENE	< 0.2
PCB-1016	< 0.25
PCB-1221	< 0.25
PCB-1232	< 0.25
PCB-1242	< 0.25

LAB#	4090945
UNITS	UG/L
PCB-1248	< 0.25
PCB-1254	< 0.25
PCB-1260	< 0.25
ENDRIN	< 0.006
ENDRIN ALDEHYDE	< 0.023

APPENDIX G

QUALITY CONTROL DATA

- DISCUSSION OF QUALITY ASSURANCE RESULTS FOR SOIL AND WATER SAMPLES
- TEST METHODS
- SOIL SAMPLES DATA
- WATER SAMPLES DATA
- MISCELLANEOUS DATA

DISCUSSION OF QUALITY ASSURANCE RESULTS
FOR
SOIL AND WATER SAMPLES

DISCUSSION OF QUALITY ASSURANCE RESULTS ON SOIL AND WATER SAMPLES

Blanks, duplicates and spiked samples were analyzed for different chemical parameters along with other soil and water samples. The results of these analyses are presented in Appendix G. The standard recovery values for the methods used as well as the actual spike recovery data is presented. Also included is the raw data from the sample analysis for sulfide, chromium, cadmium, selenium, and a GC/MS output for a sample containing detectable contamination. This data was specifically requested by Mr. W. D. Mains, Project Coordinator from USEPA. A discussion of the results of the Quality Assurance Analyses is as follows:

Soil Samples

Laboratory blanks did not show any false positives. Duplicate analysis indicated that the relative percent difference for metals in soil samples was less than $\pm$ 20 percent. Spike recoveries were within $\pm$ 30 percent except for thallium and boron. But the duplicate analysis for these two metals showed high precision. Duplicate analysis for toluene, benzene and ethylbenzene showed high relative percent difference values but showed good spike recoveries (in the range of 94 to 105 percent). Pesticide analysis showed spike recoveries in the normal range. Acid/base neutrals showed high precision (low relative percent differences) and spike recoveries. Duplicate analysis for bulk asbestos by second analyst showed good precision.

Water Samples

Spike recovery and duplicate analysis for metals indicated that the completeness and precision were within the acceptable ranges. Duplicate and spike recovery analysis for volatile organics, pesticide and acid/base neutral showed high degree of precision and completeness. The precision and spike recoveries were higher for water samples than those for soil samples as expected.

Miscellaneous Data

This data includes information on reagent solution strengths, peak heights, absorbance values and GC/MS chromatogram as requested by USEPA. This data did not show any abnormality.

TEST METHODS

PARAMETER	WATER (REFERENCE) METHOD	SOIL (REFERENCE) METHOD
Asbestos	(2) P & CAM 239	(3) ----
Aluminum	(1) 202.1	(1) 202.1
Chromium	(1) 218.1	(1) 218.1
Barium	(1) 208.1	(1) 208.1
Beryllium	(1) 210.1	(1) 210.1
Cobalt	(1) 219.1	(1) 219.1
Copper	(1) 220.1	(1) 220.1
Iron	(1) 236.1	(1) 236.1
Nickel	(1) 249.1	(1) 249.1
Manganese	(1) 243.1	(1) 243.1
Zinc	(1) 289.1	(1) 289.1
Boron	(1) 212.3	(1) 212.3
Vanadium	(1) 286.1	(1) 286.1
Silver	(1) 272.1	(1) 272.1
Arsenic	(1) 206.3	(1) 206.3
Antimony	(1) 204.1	(1) 204.1
Selenium	(1) 270.3	(1) 270.3
Thallium	(1) 279.1	(1) 279.1
Mercury	(1) 245.1	(1) 245.1
Tin	(1) 282.1	(1) 282.1
Cadmium	(1) 213.1	(1) 213.1
Lead	(1) 239.1	(1) 239.1
Ammonia	(1) 350.3	(1) 350.3
Cyanide	(1) 335.3	(1) 335.3
Sulfide	(1) 376.2	(1) 376.2
Acid Extractables	(4) 604	(5) 8040
Base/Neutrals	(4) 625	(5) 8090,8100,8110,812
Volatiles	(4) 601, 602	(5) 8010,8020,8030
Pesticides	(4) 608	(5) 8080
PCB	(4) 608	(5) 8080
Dioxins	(4) 613	(5) 8130
Thiram	(4) 608	(5) 8080

References:

(1) Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, March 1979.

(2) NIOSH Manual of Analytical Methods, Second edition, Volume 1, U.S. Dept. of Health, Education and Welfare.

(3) Interim Method for the Determination of Asbestos in Bulk Insulation samples, EPA 600/M4-82-020, December 1982.

(4) Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA 600/4-82-057, July 1982.

(5) Test Methods for the Evaluation of Solid Waste, Physical/ Chemical Methods, SW 846.

United States
Environmental Protection
Agency

Environmental Monitoring Systems
Laboratory
Research Triangle Park NC 27711

Research and Development

EPA-600/M4-82-020 Dec. 1982

EPA

Test Method

Interim Method for the Determination of Asbestos in Bulk Insulation Samples*

1. Polarized Light Microscopy

1.1 Principle and Applicability

Bulk samples of building materials taken for asbestos identification are first examined for homogeneity and preliminary fiber identification at low magnification. Positive identification of suspect fibers is made by analysis of subsamples with the polarized light microscope.

The principles of optical mineralogy are well established.[1,2] A light microscope equipped with two polarizing filters is used to observe specific optical characteristics of a sample. The use of plane polarized-light allows the determination of refractive indices along specific crystallographic axes Morphology and color are also observed. A retardation plate is placed in the polarized light path for determination of the sign of elongation using orthoscopic illumination. Orientation of the two filters such that their vibration planes are perpendicular (crossed polars) allows observation of the birefringence and extinction characteristics of anisotropic particles.

Quantitative analysis involves the use of point counting. Point counting is a standard technique in petrography for determining the relative areas occupied by separate minerals in thin sections of rock. Background information on the use of point counting[2] and the interpretation of point count data[3] is available.

This method is applicable to all bulk samples of friable insulation materials submitted for identification and quantitation of asbestos components.

1.2 Range

The point counting method may be used for analysis of samples containing from 0 to 100 percent asbestos. The upper detection limit is 100 percent. The lower detection limit is less than 1 percent.

1.3 Interferences

Fibrous organic and inorganic constituents of bulk samples may interfere with the identification and quantitation of the asbestos mineral content. Spray-on binder materials may coat fibers and affect color or obscure optical characteristics to the extent of masking fiber identity. Fine particles of other materials may also adhere to fibers to an extent sufficient to cause confusion in identification. Procedures that may be used for the removal of interferences are presented in Section 1.7.2.2.

1.4 Precision and Accuracy

Adequate data for measuring the accuracy and precision of the method for samples with various matrices are not currently available. Data obtained for samples containing a single asbestos type in a simple matrix are available in the EPA report *Bulk Sample Analysis for Asbestos Content: Evaluation of the Tentative Method.*[4]

1.5 Apparatus

1.5.1 Sample Analysis

A low-power binocular microscope, preferably stereoscopic, is used to

*An interim method is carefully drafted from available source information. This method is still under investigation and therefore is subject to revision.

examine the bulk insulation sample as received.

- *Microscope:* binocular, 10-45X (approximate)
- *Light Source:* incandescent or fluorescent
- *Forceps, Dissecting Needles, and Probes*
- *Glassine Paper or Clean Glass Plate*

Compound microscope requirements: A polarized light microscope complete with polarizer, analyzer, port for wave retardation plate, 360° graduated rotating stage, substage condenser, lamp, and lamp iris.

- *Polarized Light Microscope:* described above
- Objective Lenses: 10X, 20X, and 40X or near equivalent
- *Dispersion Staining Objective Lens* (optional)
- *Ocular Lens:* 10X minimum
- *Eyepiece Reticle:* cross hair or 25 point Chalkley Point Array
- *Compensator Plate:* 550 millimicron retardation

1.5.2 Sample Preparation

Sample preparation apparatus requirements will depend upon the type of insulation sample under consideration. Various physical and/or chemical means may be employed for an adequate sample assessment.

- *Ventilated Hood* or negative pressure glove box
- *Microscope Slides*
- *Coverslips*
- *Mortar and Pestle:* agate or porcelain (optional)
- *Wylie Mill* (optional)
- *Beakers & assorted glassware* (optional)
- *Centrifuge* (optional)
- *Filtration apparatus* (optional)
- *Low temperature asher* (optional)

1.6 Reagents

1.6.1 Sample Preparation

- *Distilled Water* (optional)
- *Dilute CH_3COOH:* ACS reagent grade (optional)
- *Dilute HCl:* ACS reagent grade (optional)
- *Sodium metaphosphate* $(NaPO_3)_6$ (optional)

1.6.2 Analytical Reagents

- *Refractive Index Liquids:* 1.490-1.570, 1.590-1.720 in increments of 0.002 or 0.004
- *Refractive Index Liquids for Dispersion Staining:* high-dispersion series, 1.550, 1.605, 1.630 (optional)
- *UICC Asbestos Reference Sample Set:* Available from: UICC MRC Pneumoconiosis Unit, Llandough Hospital, Penarth, Glamorgan CF6 1XW, UK, and commercial distributors
- *Tremolite-asbestos* (source to be determined)
- *Actinolite-asbestos* (source to be determined)

1.7 Procedures

***Note:** Exposure to airborne asbestos fibers is a health hazard. Bulk samples submitted for analysis are usually friable and may release fibers during handling or matrix reduction steps. All sample and slide preparations should be carried out in a ventilated hood or glove box with continuous airflow (negative pressure). Handling of samples without these precautions may result in exposure of the analyst and contamination of samples by airborne fibers.*

1.7.1 Sampling

Samples for analysis of asbestos content shall be taken in the manner prescribed in Reference 5 and information on design of sampling and analysis programs may be found in Reference 6. If there are any questions about the representative nature of the sample, another sample should be requested before proceeding with the analysis.

1.7.2 Analysis

1.7.2.1 Gross Examination

Bulk samples of building materials taken for the identification and quantitation of asbestos are first examined for homogeneity at low magnification with the aid of a stereomicroscope. The core sample may be examined in its container or carefully removed from the container onto a glassine transfer paper or clean glass plate. If possible, note is made of the orientation of top and bottom surfaces. When discrete strata are identified, each is treated as a separate material so that fibers are first identified and quantified in that layer only, and then the results for each layer are combined to yield an estimate of asbestos content for the whole sample.

1.7.2.2 Sample Preparation

Bulk materials submitted for asbestos analysis involve a wide variety of matrix materials. Representative subsamples may not be readily obtainable by simple means in heterogeneous materials, and various steps may be required to alleviate the difficulties encountered. In most cases, however, the best preparation is made by using forceps to sample at several places from the bulk material. Forcep samples are immersed in a refractive index liquid on a microscope slide, teased apart, covered with a cover glass, and observed with the polarized light microscope.

Alternatively, attempts may be made to homogenize the sample or eliminate interferences before further characterization. The selection of appropriate procedures is dependent upon the samples encountered and personal preference. The following are presented as possible sample preparation steps.

A mortar and pestle can sometimes be used in the size reduction of soft or loosely bound materials, though this may cause matting of some samples. Such samples may be reduced in a Wiley mill. Apparatus should be clean and extreme care exercised to avoid cross-contamination of samples. Periodic checks of the particle sizes should be made during the grinding operation so as to preserve any fiber bundles present in an identifiable form. These procedures are not recommended for samples that contain amphibole minerals or vermiculite. Grinding of amphiboles may result in the separation of fiber bundles or the production of cleavage fragments that have aspect ratios greater than 3:1 and will be classified as asbestos fibers. Grinding of vermiculite may also produce fragments with aspect ratios greater than 3:1.

Acid treatment may occasionally be required to eliminate interferences. Calcium carbonate, gypsum, and bassanite (plaster) are frequently present in sprayed or trowelled insulations. These materials may be removed by treatment with warm dilute acetic acid. Warm dilute hydrochloric acid may also be used to remove the above materials. If acid treatment is required, wash the sample at least twice with distilled water, being careful not to lose the particulates during decanting steps. Centrifugation or filtration of the suspension will prevent significant fiber loss. The pore size of the filter should be 0.45 micron or less. *Caution: prolonged acid contact with the sample may alter the optical characteristics of chrysotile fibers and should be avoided.*

Coatings and binding materials adhering to fiber surfaces may also be removed by treatment with sodium metaphosphate.[7] Add 10 mL of 10 g/L sodium metaphosphate solution to a small (0.1 to 0.5 mL) sample of bulk material in a 15-mL glass centrifuge tube. For approximately 15 seconds each, stir the mixture on a vortex mixer, place in an ultrasonic bath and then shake by hand. Repeat the series

Collect the dispersed solids by centrifugation at 1000 rpm for 5 minutes. Wash the sample three times by suspending in 10 mL distilled water and recentrifuging. After washing, resuspend the pellet in 5 mL distilled water, place a drop of the suspension on a microscope slide, and dry the slide at 110°C.

In samples with a large portion of cellulosic or other organic fibers, it may be useful to ash part of the sample and examine the residue. Ashing should be performed in a low temperature asher. Ashing may also be performed in a muffle furnace at temperatures of 500°C or lower. Temperatures of 550°C or higher will cause dehydroxylation of the asbestos minerals, resulting in changes of the refractive index and other key parameters. If a muffle furnace is to be used, the furnace thermostat should be checked and calibrated to ensure that samples will not be heated at temperatures greater than 500°C.

Ashing and acid treatment of samples should not be used as standard procedures. In order to monitor possible changes in fiber characteristics, the material should be viewed microscopically before and after any sample preparation procedure. Use of these procedures on samples to be used for quantitation requires a correction for percent weight loss.

1.7.2.3 Fiber Identification

Positive identification of asbestos requires the determination of the following optical properties.

- Morphology
- Color and pleochroism
- Refractive indices
- Birefringence
- Extinction characteristics
- Sign of elongation

Table 1-1 lists the above properties for commercial asbestos fibers. Figure 1-1 presents a flow diagram of the examination procedure. Natural variations in the conditions under which deposits of asbestiform minerals are formed will produce exceptions to the published values and differences from the UICC standards. The sign of elongation is determined by use of the compensator plate and crossed polars. Refractive indices may be determined by the Becke line test. Alternatively, dispersion staining may be used. Inexperienced operators may find that the dispersion staining technique is more easily learned, and should consult Reference 9 for guidance. Central stop dispersion staining colors are presented in Table 1-2. Available high-dispersion (HD) liquids should be used.

1.7.2.4 Quantitation of Asbestos Content

Asbestos quantitation is performed by a point-counting procedure. An ocular reticle (cross-hair or point array) is used to visually superimpose a point or points on the microscope field of view. Record the number of points positioned directly above each kind of particle or fiber of interest. Score only points directly over asbestos fibers or nonasbestos matrix material. Do not score empty points for the closest particle. If an asbestos fiber and a matrix particle overlap so that a point is superimposed on their visual intersection, a point is scored for both categories. Point counting provides a determination of the area percent asbestos. Reliable conversion of area percent to percent of dry weight is not currently feasible unless the specific gravities and relative volumes of the materials are known.

For the purpose of this method, "asbestos fibers" are defined as having an aspect ratio greater than 3:1 and being positively identified as one of the minerals in Table 1-1.

A total of 400 points superimposed on either asbestos fibers or nonasbestos matrix material must be counted over at least eight different preparations of representative subsamples. Take eight forcep samples and mount each separately with the appropriate refractive index liquid. The preparation should not be heavily loaded. The sample should be uniformly dispersed to avoid overlapping particles and allow 25-50 percent empty area within the fields of view. Count 50 nonempty points on each preparation, using either

- A cross-hair reticle and mechanical stage; or
- A reticle with 25 points (Chalkley Point Array) and counting at least 2 randomly selected fields.

For samples with mixtures of isotropic and anisotropic materials present, viewing the sample with slightly uncrossed polars or the addition of the compensator plate to the plane polarized light path will allow simultaneous discrimination of both particle types. Quantitation should be performed at 100X or at the lowest magnification of the polarized light microscope that can effectively distinguish the sample components. Confirmation of the quantitation result by a second analyst on some percentage of analyzed samples should be used as standard quality control procedure.

The percent asbestos is calculated as follows:

$$\% \text{ asbestos} = (a/n)\,100\%$$

where

a = number of asbestos counts,
n = number of nonempty points counted (400).

If $a = 0$, report "No asbestos detected." If $0 < a \leq 3$, report "<1% asbestos."

The value reported should be rounded to the nearest percent.

1.8 References

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SAMPLE HANDLING SCHEME FOR KMA SOIL SAMPLES

The following steps were taken to prepare the soil samples for viewing:

1) Forceps were used to sample from several places of the bulk material to yield a total sample quantity of 0.1 to 0.5 ml.

2) Due to the moist nature of most of the samples and because of interferences encountered when using refractive index liquids on wet samples the sample material was placed on a watch glass in a convection oven at 110°C until dry.

3) If, after step two the sample was found to contain only fairly fine particulate matter forceps were then used to immerse the sample in a refractive index liquid on a slide, teased apart with dissection needles, a cover slip installed. The sample was then observed using polarized light microscopy techniques.

4) If, after step two, large granular particles and/or soft loosely bound materials were observed, a moitac and pistle was used for size reduction. The sample was then analyzed as described in Step 3.

The remainder of the actual bulk analysis was carried out according to the EPA Interim Method for the Determination of Asbestos in Bulk Insulation Samples.

METHOD FOR ASBESTOS FIBERS IN WATER

Principle of the Method

This method is an adaptation of the NIOSH P&CAM239 method and is used to determine asbestos fiber concentrations in water. This method is not meant to count all asbestos fibers in all size ranges or to differentiate asbestos from other fiberous particulates.

Immediately after thoroughly shaking the sample to re-entrain any settled fibrous material a known volume of samples is drawn through a Gelman GM-4, 0.8 um, 47 mm diameter Metricel Membrane Filter using a Millipore filter funnel apparatus and vacuum pump. The sample filter is then dried in a convection oven at 60°C to remove any remaining water. Next the filter is transformed from an opaque solid membrane to a transparent optically homogeneous gel. The fibers are sized and counted using a phase-contrast miscroscope at 400-450X magnification.

Definitions: Asbestos fiber, for counting purposes, means a particulate which has a physical dimension longer than 5 micrometers and with a length to diameter ratio of 3 to 1 or greater. Asbestos includes chrysotile, cummingtonite-grunerite (amosite), crocidolite, fibrous tremolite, fibrous anthophyllite, and fibrous actinolite.

Optical Equipment and Microscope Features

Microscope body with binocular head.

10 X Huygenian eyepieces are recommended. Other eyepieces can be substituted if necessary. Wide field eyepieces can be used; however, wide field eyepieces may yield a count field area less than 0.003 mm^2 with the Porton reticle. This is not always desirable from the standpoint of obtaining optimum sampling times. If wide field eyepieces are used, it is preferable to use the Patterson Globe and Circle reticle to obtain a larger count field area.

Kochler illumination (preferably built-in with provisions for adjusting light intensity).

A Porton reticle is recommended. Others such as the Patterson Globe and Circle can be substituted.

Mechanical stage.

Reagents

Chemicals should be reagent grade, free from particles and color, conforming to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specification are available.

Dimethyl phthalate

Diethyl oxalate

Avoid getting the mounting solution on the skin. Wash skin promptly with soap and water if skin contact occurs.

Sample Preparation

Preparation of Mounting Solution

A very important part of the sample evaluation is the mounting process. This process involves a special mounting medium of prescribed viscosity. The proper viscosity is important in order to expedite filter dissolving and still mimimize particle migration. After the sample has been mounted; an elasped time of approximately sixty minutes is needed before the sample is ready for evaluation.

Combine the dimethyl phthalate and diethyl oxalate in a one to one ratio by volume and pour into a Wheaton balsam bottle. Add approximately 0.05 ($\pm$ 0.005) grams of new membrane filter per milliliter of solution to reach the necessary viscosity. The mixture must be stirred periodically until the filters have dissolved and a homogeneous mixture is formed. The normal shelf life of the mounting solution is about three months. Twenty milliliters of mounting solution will prepare approximately 300 samples.

Sample Mounting

Cleanliness is important! A dirty working area may result in sample contamination and erroneous counts. The following steps should be followed when mounting a sample.

Clean the slides and cover slips with leans tissue. Lay each slide down on a clean surface with the frosted end up. It is a good practice to rest one edge of the cover slip on the slide and the other edge on the working surface. By doing this, you keep the bottom surface (the one which contacts the filter) from becoming contaminated.

Phase-Contrast condenser with a numberical aperture (N.A.) equal to or greater than the N.A. of the objective.

40-45X phase contrast achromatic objective (N.A. 0.65 to 0.75).

Phase-ring centering telescope or Bertrand lens.

Green or blue filter, if recommended by microscope manufacturer.

Stage Micrometer with 0.01 mm subdivisions.

For general guidance on phase contrast microscopy, consult Needham, Clark and McCrone.

Filter Mounting Equipment

Experience has shown that certain equipment is useful for efficient sample mounting. The following items are recommended for extracting and mounting a portion of the filter for counting.

Microscope slides. 2.5 by 7.5 cm glass slides are most commonly used. Sample number, data, initials, etc., can be conveniently written on a frosted end slide.

Cover Slips. Cover slips are a necessary part of the slide mount and optical system. The shape should be appropriate for the size of the filter wedge. The appropriate cover slip depends upon the objective to be used. Ordinarily, objectives are optically corrected for a #1½ (0.17 millimeter) thickness cover slip. Improper cover glass thickness will detract from the final image quality.

Scalpel. A scalpel is needed to cut out a portion of the filter to be examined. A number-ten curved blade scalpel is recommended.

Tweezers. A pair of fine-tipped tweezers is used to remove the membrane filter slice from the field monitor and place it upon the slide.

Lens Tissue. To insure cleanliness, a lint-free tissue is recommended. This tissue should also be used for wiping mounting tools and for cleaning slides and cover slips.

Glass Rod. A fire-polished glass rod may be used to spread the mounting solution on the slide.

Wheaton Balsam Bottle. This special glass container has a glass top which prevents contamination of the mounting solution. A glass rod is included for dispensing the solution.

Counting of Fibers

Place the slide on the mechanical stage of the microscope and position the center of the wedge under the objective lens and focus upon the sample. Start counting from one end of the wedge and progress along a radial line to the other end (count in either direction from perimeter to wedge tip). Random fields are selected, without looking into the eyepieces, by slightly advancing the slide in one direction with the mechanical stage control.

It is essential to continually scan over a range of focal planes (generally the upper 10 to 15 micrometers of the filter surface) with the fine focus control during each field count. This is especially necessary for asbestos fibers due to their impaction into the filter matrix.

On most airbone samples, asbestos fibers will generally have fiber diameters less than one micrometer. Therefore, it is necessary to look carefully for faint fiber images.

Regularly check phase ring alignment.

When an aggolomerate (mass of meterial) covers a significant portion of the field of view (approx 1/6 or greater) reject the field and select another. (Do not include it in the number of fields counted.) However, report the fact as it may have meaning on other data collection.

Bundles of fibers are counted as one fiber unless both ends of the fiber can be clearly resolved.

Count only fibers with a length to width ratio greater than or equal to 3:1.

Count only fibers greater than 5 micrometers in length. (Be as accurate as possible in accepting fibers near this length.) Measure curved fibers along the curve to estimate the total length.

Count as many fields as necessary to yield a total count of at least 100 fibers. Exception: a) count at leat 20 fields even if you count more than 100 fibers, and b) stop at 100 fields even if you haven't reached 100 fibers.

For fibers that cross either one or two sides of the counting field, the following procedure is used to obtain a representative count.

Count any fiber greater than 5 micrometers in length, that lies entirely within the counting area. Count as "1/2 fiber"any fiber with only one end lying within the counting area. Do not count any fiber crossing any two sides. Reject and do not count all other fibers.

Wipe all the mounting tools clean with leans tissue and place then on a clean surface (such as lens tissue). All tools should be wiped clean prior to mounting each sample.

Using the glass rod supplied with the Wheaton balsam bottle, apply a drop of mounting solution onto the center of the slide. It may be necessary to adjust the quantity of solution so that after the cover slip has been placed on top, the solution extends only slightly beyond the filter boundary. If the quantity is greater than this particle migration may occur.

Using another glass rod, spread the mounting media into a triangular shape. The size of this triangle should coincide with the dimension of the filter wedge. Cut a triangular wedge from the center to the edge of the filter using the scalpel. The size of the wedge should approximate one-eighth of the filter surface.

Grasp the filter wedge with the tweezers on the perimeter. Do not touch the filter with your fingers. Place the wedge, sample side up upon the mounting medium.

Pick up a clean cover slip with tweezers and carefully place it on the filter wedge. Once this contact has been made, do not reposition the cover slip.

Label the slide with the sample number and current date before proceeding to the next filter. On the bottom (backside) of the slide, trace the perimeter of the filter wedge with a felt tip marking pen. This will enable the counter, after the filter has become transparent, to stay within the filter perimeter when counting.

The sample should become transparent within fifteen minutes. If the filter appears cloudy, it may be necessary to press very lightly on the cover slip. This is rarely necessary; however, counting should not be started until an hour after the mounting. This allows the microscopic texture of the filter to become invisible to microscope viewing.

Discard the sample mount after two days if it has not been counted. Crystals appearing similar to asbestos fibers may begin to grow at the mounting media/air interfaces. They seldom present any problems if the slide is examined before two days. In any case, stay away from the filter's edges when counting and sizing.

Microscope Setup

Porton reticle and the Counting Field

The asbestos fiber count procedure consist of comparing fiber length to the diameters of calibrated circles of a Porton reticle, and counting all fibers greater than 5 micrometers in length lying within a given counting field area. The Porton reticle is a glass plate inscribed with a series of circles and rectangles. The left half of the reticle is divided into six rectangles constituting the counting field.

Placement in Eyepiece

The Porton reticle is placed inside the Huygenian eyepiece where it rests on the field limiting diaphragm. If other types of eyepieces are used, it may be necessary to insert a counting collar for retaining the reticle. The reticle should always be kept clean, since dirt on the reticle is in focus and could complicate the counting and sizing process.

Stage Micrometer

The Porton reticle cannot be used for counting until it has been properly calibrated with a stage micrometer. Most srage micrometer scales are approximately two millimeters long and are divided into units of one-hundredth of a millimeter (ten micrometers).

Microscope Adjustment

When adjusting the microscope, following the manufacturer's instructions while observing the following guidelines.

1. The light source image must be in focus and centered on the condenser iris or annular diaphragm.
2. The particulate material to be examined must be in focus.
3. The illuminator field iris must be in focus, centered on the sample, and opened only to the point where the field of view is illuminated.
4. The phase rings (annular diaphragm and phase-shifting elements) must be concentric.

Porton Reticle Calibration Procedure

Each eyepiece objective reticle combination on the microscope must be calibrated. Should any of the three by changed (Disassembly, replacement, zoom adjustment, etc.), the combination must be recalibrated. Calibration may change if interpupillary distance is changed. For proper calibration, the following procedure should be followed closely.

With a 10X objective in place, place the stage micrometer on the mechanical stage, focus the millimeter scale, and center the image. Change to the 40-45X objective and adjust the first millimeter scale division to coincide with the left boundary of the Porton rectangle. Measure the distance between the left and extreme right boundaries of the Porton rectangle, estimating any portion of the final division. This measurement represents 200 L units. The rectangle is 10) L units on the short vertical dimension. The calculated "L" is inserted into the formula $D=L(2^n)^{1/2}$ where "N" is the circle number (indicated on the reticle) and "D" is the circle diameter. Since the circle diameters vary logarithmically, every other circle doubles in diameter. For example, circle number three is twice the diameter of number one; number four is twice the diameter of number two. When the circle sizes have been determined, the counting field area which consists of the left six smaller rectangles can be calculated from the relation 10,000 L^2. This completes the reticle callibration for this specific objective-eyepiece-reticle combination.

Example for Porton Reticle

The following calibration was obtained for a pair of 10X Huygenian eyepieces and a 32X objective:

200L = 0.148 mm = 148 micrometers

100L = 0.074 mm = 74 micrometers

One L unit = 0.74 micrometers

Thus Circle #1 has a diameter $D=L(2^n)^{\frac{1}{2}}$ = 0.74 (1.414) = 1.05 micrometers.

Then our circle diameter calibration table looks like:

Diameter of Circle #1 = 1.05 micrometers
#2 = 1.48
#3 = 2.09
#4 = 2.96
#5 = 4.19
#6 = 5.92

Field area = $(10,000)(L^2)$ = (100 L) (100 L) =(0.074) (0.074) -0.0055

Thus fibers with a lenth greater than a distance halfway between the diameters of the #5 and #6 circles would be counted.

If a Patterson Glove and Circle reticle is used, a different calculation procedure is required. The circle diameters are related as follows. The #25 circle diameter is (0.1)(reticle length)

The circle diameters are proportional to the ratio of their numbers. Thus the #20 circle diameter is (20/25) or 0.8 times the #25 circle diameter.

Calculations

The number of asbestos fibers per liter of water is calculated using the following formula:

$$WC \leq \frac{[(FB/FC) - (BFB/BFL)]\ ECA) \times 1000}{(TVW)\ (MFA)}$$

WC= water fiber concentration in (fibers <5 um)/liter^3

BFB= total number of fibers counted in the BFL fields of the blank or control filters in fibers <5 um.

BFL= total number of fields counted on the blank or control filters.

ECA= effective collecting area of filter (855 mm^2 for a 37 mm filter with effective diameter of 33 mm).

FB= total number of fibers counted on the FL fields in fibers < 5 um.

FL = total number of fields counted on the filter

MFA= microscope count field area on mm^2 (generally 0.003 to 0.006)

TVW= total volume of water passed through filter.

Determination of Asbestos

After the total number of fibers per liter of water has been determined the sample slide may be observed under a cross-polar condition using polarized light microscopy to determine whether any of the fibrous material is actually asbestos. An additional and somewhat more specific check would be to evaporate a volume of water and examine the remianing residue, after being throughly dried, using polarized light microscopy.

SOIL SAMPLES

Note: Sample I.D. Number 9-503 is Synonymous to 4090-503
(Refer to Table 4-1 for sample location and depth)

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-503	Al	96.00	<0.10	1,380	1,290	
9-504	Al	101.40	<0.10	3,760	3,260	
9-512	Al	96.00	<0.10	3,544	3,484	
9-505	Sb	96.75	<0.002	<0.3	<0.3	101.44
9-506	Sb	96.75	<0.002	<0.3	<0.3	118.93
9-522	Sb	96.75	<0.002	<0.3	<0.3	94.18
9-505	As	109.57	<0.002	3.220	3.199	85.05
9-506	As	109.57	<0.002	0.7982	0.4433	97.90
9-503	Ba	105.40	<0.10	262.0	182.0	
9-504	Ba	112.20	<0.10	484.0	658.0	88.50
9-512	Ba	105.40	<0.10	142.0	135.4	79.70
9-503	Be	97.30	<0.01	19.4	15.2	55.93
9-504	Be	92.57	<0.01	<0.20	<0.20	49.33
9-512	Be	97.30	<0.01	< .20	<0.20	90.00
9-503	Cd	104.0	<0.01	1.0	1.0	70.55
9-504	Cd	90.90	<0.01	<0.20	<0.20	74.20
9-512	Cd	104.0	<0.01	1.0	0.80	73.50
9-503	Cr	90.0	<0.02	9.2	8.8	81.00
9-504	Cr	95.65	<0.02	80.0	82.0	72.00
9-512	Cr	90.0	<0.02	5.2	5.6	

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-503	Co	93.30	< 0.01	19.4	15.2	128.80
9-504	Co	94.50	< 0.01	6.76	6.98	71.32
9-512	Co	93.30	< 0.01	20.4	24.2	86.05
9-503	Cu	97.00	< 0.01	62.4	79.0	82.75
9-504	Cu	94.25	< 0.01	109.8	151.0	94.00
9-512	Cu	97.00	< 0.01	57.2	59.8	100.75
9-503	Fe	96.00	< 0.02	3,440	3,240	-----
9-504	Fe	94.33	< 0.02	4,580	5,080	-----
9-512	Fe	96.00	< 0.02	4,980	3,840	-----
9-503	Pb	97.60	< 0.05	598	658	-----
9-504	Pb	102.40	< 0.05	1,068	1,152	120.00
9-512	Pb	97.60	< 0.05	326	330	112.00
9-503	Mn	97.67	< 0.01	134.0	131.6	127.7
9-504	Mn	95.67	< 0.01	150.2	155.6	88.17
9-512	Mn	97.67	< 0.01	98.6	98.0	
9-503	Hg	95.71	<0.0005	0.018	0.032	113.20
9-517	Hg	95.71	< 0.0005	0.058	0.073	85.00
9-522	Hg	103.60	<0.0005	0.071	0.068	94.70
9-503	Ni	90.50	< 0.02	26.4	24.8	74.0
9-504	Ni	100.00	< 0.02	198.0	200.0	77.50
9-512	Ni	90.50	< 0.02	30.4	27.4	63.80

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-503	Tl	99.80	<0.02	<0.4	<0.4	99.6
9-504	Tl	99.00	<0.02	<0.4	<0.4	81.20
9-512	Tl*	99.80	<0.02	<0.4	<0.4	46.80
9-505	Se	104.71	<0.001	0.095	0.080	79.37
9-508	Se	104.71	<0.001	0.040	<0.04	130.08
9-503	Sn	127.8	<1.0	<1.0	<1.0	131.00
9-504	Sn	127.8	<1.0	<1.0	<1.0	52.10
9-512	Sn	127.8	<1.0	<1.0	<1.0	131.00
9-503	V	136.90	<0.10	19.4	15.2	128.80
9-504	V	119.90	<0.10	14.2	14.2	99.60
9-512	V	136.90	<0.10	20.4	24.2	86.00
9-503	Zn	108.00	<0.01	368	348	105.00
9-504	Zn	99.00	<0.01	1,480	1,602	-----
9-512	Zn	108.00	<0.01	296	320	-----
9-503	Ag	88.00	<0.01	1.74	1.83	106.60
9-504	Ag	88.00	<0.01	2.82	2.73	98.78
9-512	Ag	88.00	<0.01	1.35	1.47	107.67
* This sample was digested and analyzed twice as duplicates and spikes.						
Both spike recoveries were approximately 47%.						

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-698	Al	101.40	<0.10	5,220	5,800	------
9-698	Sb	97.00	<0.002	<0.3	<0.3	110.98
9-698	As	102.65	<0.002	2.20	4.69	114.52
9-698	Ba	112.20	<0.10	604.0	762.0	------
9-698	Be	92.57	<0.01	<0.20	< 0.20	59.50
9-698	Cd	90.90	<0.01	0.32	< 0.20	72.25
9-698	Cr	95.65	<0.02	24.28	21.10	116.98
9-698	Co	94.50	<0.01	5.14	2.90	77.78
9-698	Cu	94.25	<0.01	752.4	999.8	------
9-698	Fe	94.33	<0.02	11,840	13,900	-----
9-968	Pb	102.40	<0.05	4,700	4,620	------
9-968	Mn	95.67	<0.01	446	450	86.67
9-700	Hg	100.60	<0.0005	0.0373	0.0373	103.06
9-698	Ni	100.00	<0.02	63.4	60.2	118.50
9-968	Tl	99.00	<0.02	<0.4	< 0.4	81.60
9-968	Se	87.71	<0.001	0.085	0.115	78.58
9-968	Sn	127.80	<1.0	<1.0	< 1.0	61.50
9-968	V	119.90	<0.10	21.2	13.8	107.95
9-698	Zn	99.00	<0.01	1,840	1,856	-----
9-968	Ag	92.20	<0.01	2.40	2.16	102.07

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-705	Boron	100	0	2.2	2.4	19
9-46	Ammonia	109	< 0.1	0.976	1.01	99
9-600	Ammonia	96	< 0.1	0.453	0.419	97
9-515	Ammonia	87	< 0.1	< 10.0	< 10.0	90
9-505	Cyanide	100	< 0.01	0.29	0.29	77
9-503	Cyanide	100	< 0.01	1.50	1.50	96
9-501	Cyanide	100	< 0.01	2.7	3.0	78
9-516	Boron	100	< 0.02	18	15	47
9-508 --	Boron *	100	< 0.02	28	11	39
9-704	Boron	100	< 0.02	1.7	1.9	31
9-502	Sulfide **	100	< 0.1	< 0.5	< 0.5	20
9-508	Sulfide	100	< 0.1	< 0.5	< 0.5	100
9-512	Sulfide	100	< 0.1	< 0.5	< 0.5	100
9-504	Sulfide	100		<0.5	<0.5	86

* This sample was tested three times for boron (duplicates and spikes also). All duplicates had a level of precision at ± 83% to ± 94%. The results reported are from one test run and are typical of the other two sets of data.

** This sample was tested for sulfides twice (duplicate and spikes also) with both spikes recoveries at 20.0%.

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-705	Cyanide	100	0	4.4	2.0	98
9-704	Boron	100	0	1.7	1.9	32
9-47	Ammonia	102	< 0.1	1.03	1.03	96
9-998	Sulfide	100	< 0.1	< 0.5	<0.5	60
9-999	Sulfide	100	< 0.1	< 0.5	<0.5	100
9-700	Sulfide	100	< 0.1	< 0.5	<0.5	140

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-510	Chloroethane		<0.2	<0.2	<0.2	105
"	Methylene chloride		<0.4	<0.4	<0.4	68
"	Chloroform		<0.4	<0.4	<0.4	98
"	1,1,1-Trichloroethane		<0.2	<0.2	<0.2	95
"	Trichloroethene		<0.2	<0.2	<0.2	96
"	Tetrachloroethene		<0.2	<0.2	<0.2	95
"	Chlorobenzene		<0.02	<0.02	<0.02	85
"	1,2-Dichlorobenzene		<0.04	<0.04	<0.04	50
	Toluene		<0.02	0.62	2.7	100
	Benzene		<0.02	0.06	0.19	94
	Ethylbenzene		<0.02	1.4	8.2	105

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-520	Chloroethane		< 0.2	< 0.2	< 0.2	52
"	Methylene chloride		<0.4	< 0.4	< 0.4	40
"	Chloroform		< 0.4	< 0.4	< 0.4	60
"	1,1,1-Trichloroethane		< 0.2	< 0.2	< 0.2	58
"	Trichloroethene		< 0.2	< 0.2	< 0.2	66
"	Tetrachloroethene		< 0.2	< 0.2	< 0.2	82
"	Chloroebenzene		< 0.02	< 0.02	< 0.02	79
"	1,2-Dichlorobenzene		< 0.04	< 0.04	< 0.04	118
"	Toluene		< 0.02	< 0.02	< 0.02	69
"	Benzene		< 0.02	< 0.02	< 0.02	63
"	Ethylbenzene		< 0.02	< 0.02	< 0.02	84

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-704	Chloroform		<0.4	<0.4	<0.4	101
"	Chloroethane		<0.2	<0.2	<0.2	105
"	Methylene chloride		<0.4	<0.4	<0.4	90
"	1,1,1-Trichlorothene		<0.2	<0.2	<0.2	98
"	Trichloroethene		<0.2	<0.2	<0.2	100
"	Chlorobenzene		<0.02	<0.02	<0.02	92
"	1,2-Dichlorobenzene		<0.04	<0.04	<0.04	68
"	Toluene		<0.02	<0.02	<0.02	97
"	Benzene		<0.02	<0.02	<0.02	100
"	Ethylbenzene		<0.02	<0.02	<0.02	92

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-514	PCB		<0.1	<0.1	<0.1	120
"	Aldrin		<0.004	<0.004	<0.004	64
"	p,p'-DDE		<0.004	<0.004	<0.004	80
"	p,p'-DDT		<0.012	<0.012	<0.012	110
"	Endosulfan I		<0.014	<0.014	<0.014	95
"	Thiram		<0.028	<0.028	<0.028	47
"	2-Chlorophenol		<0.02	<0.02	<0.02	82
"	2-Nitrophenol		<0.02	<0.02	<0.02	98
"	2,4-Dinitrophenol		<0.02	<0.02	<0.02	82

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-520	PCB		<0.1	<0.1	<0.1	83
"	Aldrin		<0.004	<0.004	<0.004	75
"	p,p'DDE		<0.004	<0.004	<0.004	39
"	p,p'-DDT		<0.012	<0.012	<0.012	78
"	Endosulfan I		<0.014	<0.014	<0.014	56
"	Thiram		<0.028	<0.018	<0.028	56
"	2-Chlorophenol		<0.02	<0.02	<0.02	74
"	2-Nitrophenol		<0.02	<0.02	<0.02	89
"	2,4-Dinitrophenol		<0.02	<0.02	<0.02	79
9-523	Thriam		---	---	---	44
9-505	Thriam		---	---	---	57
9-705	Thriam		---	---	---	59

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-514	2,4-Dichlorophenol		<0.01	<0.01	<0.01	85
"	2,4,6-Trichlorophenol		<0.03	<0.03	<0.03	106
"	4-Chloro-3-methylphenol		<0.02	<0.02	<0.02	77
"	Pentachlorophenol		<0.3	<0.3	<0.3	107
"	Bis(2-chloroethy)ether		<0.028	<0.028	<0.028	83
"	1,4-Dichlorobenzene		<0.028	<0.028	<0.028	84
"	Hexachloroethane		<0.028	<0.028	<0.028	86
"	Nitrobenzene		<0.028	<0.028	<0.028	83
"	2-Chloronaphthylene		<0.028	<0.028	<0.028	83
"	Naphthalene		<0.028	0.26	0.19	84
"	2,4-Dinitrotoluene		<0.14	<0.14	<0.14	82
"	Phenanthracene		<0.028	<0.028	<0.028	59
"	Di-n-butylphthalate		<0.028	0.12	0.17	87
"	Bis(2-ethylhexyl)phthalate		0.05	4.2	3.7	54
"	Di-n-octylphthalate		<0.028	1.9	1.2	54
"	Acenaphthylene		<0.028	0.032	<0.028	54
"	Fluoranthene		<0.028	0.12	0.097	54
"	Fluorene		<0.028	0.031	0.039	54
"	Phenanthrene		<0.028	0.27	0.19	54
"			<0.028			54

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-520	2,4-Dichlorophenol		< 0.01	< 0.01	< 0.01	90
"	2,4,6-Trichlorophenol		< 0.03	< 0.03	< 0.03	103
"	4-Chloro-3-methylphenol		< 0.02	< 0.02	< 0.02	92
"	Pentachlorophenol		< 0.3	< 0.3	< 0.3	102
"	Bis(2-chloroethyl)ether		< 0.028	< 0.028	< 0.028	91
"	1,4-Dichlorobenzene		< 0.028	< 0.028	< 0.028	92
"	Hexachloroethane		< 0.028	< 0.028	< 0.028	96
"	Nitrobenzene		< 0.028	< 0.028	< 0.028	92
"	Naphthalene		< 0.028	< 0.028	< 0.028	93
"	2-Chloronaphthylene		< 0.028	< 0.028	< 0.028	92
"	Phenanthracene		< 0.028	< 0.028	< 0.028	96
"	Di-n-butylphthalate		< 0.028	< 0.02	< 0.02	98
"	Bis(2-ethylhexyl)phthalate		0.07	2.0	2.1	110
"	Di-n-octylphthalate		0.04	0.58	0.50	------
"	2,4-Dinitrotoluene		< 0.14	< 0.14	< 0.14	88

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-700	PCB		<0.1	<0.1	<0.1	85
"	Aldrin		<0.004	<0.004	<0.004	77
"	p,p'-DDE		< 0.004	<0.004	<0.004	59
"	p,p'-DDT		< 0.012	<0.012	<0.012	76
"	Endosulfan I		<0.014	< 0.014	<0.014	71
"	Thiram		<0.028	<0.028	<0.028	62
"	2-Chlorophenol		<0.02	<0.02	<0.02	42
"	2-Nitrophenol		<0.02	<0.02	<0.02	68
"	2,4-Dinitrophenol		<0.02	<0.02	<0.02	41

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-700	2,4-Dichlorophenol		<0.01	<0.01	<0.01	58
"	2,4,6-Trichlorophenol		<0.03	<0.03	<0.03	73
"	4-Chloro-3-methylphenol		<0.02	<0.02	<0.02	62
"	Pentachlorophenol		<0.3	<0.3	<0.3	80
"	Bis(2-Chloroethyl)ether		<0.028	<0.028	<0.028	79
"	1,4-Dichlorobenzene		<0.028	<0.028	<0.028	78
"	Hexachloroetheane		<0.028	<0.028	<0.028	82
"	Nitrobenzene		<0.028	<0.028	<0.028	79
"	Naphthalene		<0.028	<0.028	<0.028	81
"	2-Chloronaphthylene		<0.028	<0.028	<0.028	81
"	2,4-Dinitrotoluene		<0.14	<0.14	< 0.14	80
"	Phenanthracene		<0.028	<0.028	<0.028	57
"	Di-n-butyl phthalate		<0.028	<0.028	<0.028	82
"	Bis(2-ethylhexyl)phthalate		0.049	1.2	0.92	67
"	Di-n-octylphthalate		0.03	0.064	0.073	---------

BULK ASBESTOS IDENTIFICATION AND QUANTIFICATION FORM

Analyst ID: Mike Levine Date: 10/13/85

Sample ID: 9503

Asbestos Fibers Present? None

Type of Fibers Present: Cellulose

Comments: Sample dried, then crushed

Slide #	Number of Asbestos Counts	Number of Non-Asbestos Counts
1		
2		
3		
4		
5		
6		
7		
8		

BULK ASBESTOS IDENTIFICATION AND QUANTIFICATION FORM

Analyst ID: Mike Levine Date: 10/13/85

Sample ID: 4-512

Asbestos Fibers Present? None

Type of Fibers Present: Glass

Comments:

Slide #	Number of Asbestos Counts	Number of Non-Asbestos Counts
1		
2		
3		
4		
5		
6		
7		
8		

BULK ASBESTOS IDENTIFICATION AND QUANTIFICATION FORM

Analyst ID: Paul Steward Date: 2/25/85

Sample ID: Q-512 (duplicate)

Asbestos Fibers Present? NO

Type of Fibers Present: some glass

Comments: Sample was dry ground

Slide #	Number of Asbestos Counts	Number of Non-Asbestos Counts
1		
2		
3		
4		
5		
6		
7		
8		

CLIENT ID. _____

Date Rec'd	Lab #	% Crocidolite	% Amosite	% Chrysotile
10/12/84	9-501	0	0	0
10/12/84	9-502	0	0	0
10/12/84	9-503	0	0	0
10/12/84	9-504	0	0	0
10/12/84	9-505	0	0	0

WATER SAMPLES

Note: Sample I.D. Number 9-943 is Synonymous to 4090-943 (Refer to Laboratory Test Data Sheets for Well Location)

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-943	Al	100.80	<0.10	<0.10	0.15	99.4
9-944	Sb	109.50	<0.002	<0.002	<0.002	114.19
9-943	Ba	105.40	<0.10	0.25	0.10	100.70
9-944	As	98.93	<0.002	<0.002	<0.002	118.11
9-943	Be	97.87	<0.01	<0.01	<0.01	92.97
	Cd	FURANCE -	STANDARD ADDITIONS METHOD			
	Cr	FURANCE -	STANDARD ADDITONS METHOD			
9-943	Co	94.97	<0.01	<0.01	<0.01	95.10
9-943	Cu	100.90	<0.01	<0.01	<0.01	101.20
9-943	Fe	93.33	<0.02	0.08	0.08	93.67
	Pb	FURANCE -	STANDARD ADDITIONS METHOD			
9-943	Mn	95.33	<0.01	0.02	0.01	91.50
9-940	Hg	94.60	<0.0005	<0.0005	<0.0005	81.40
9-944	Ni	91.00	<0.02	<0.02	<0.02	93.50
9-944	Se	111.00	<0.001	<0.001	<0.001	127.25
9-943	Ag	90.90	<0.01	<0.01	<0.01	113.29
9-943	Tl	104.20	<0.02	<0.02	<0.02	99.40
9-943	Sn	100.25	<1.0	<1.0	<1.0	71.85
9-943	V	127.7	<0.10	<0.10	<0.10	107.30
9-943	Zn	99.00	0.02	<0.01	<0.01	100.50

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
10-521	Cyanide	100	0	< 0.02	< 0.02	100
9-939	Boron	100	0	0.97	0.97	98
9-939	Ammonia	101	< 0.1	2.49	2.07	67
9-699	Sulfide	100	< 0.1	< 0.1	< 0.5	100
9-943	Ammonia	96	<0.1	0.600	0.586	83
9-939	Boron	100	<0.02	0.97	0.97	95
9-699	Sulphide	100	<0.1	<0.5	<0.5	100
10-524	Cyanide	100	<0.02	<0.02	<0.02	101

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-939	2,4-Dichlorophenol		< 0.0003	< 0.0003	<0.0003	105
9-939	2,4,6-Trichlorophenol		< 0.0006	< 0.0006	<0.0006	110
9-939	4-Chloro-3-methylphenol		< 0.0004	< 0.0004	<0.0004	84
9-939	Pentachlorophenol		< 0.007	< 0.007	<0.007	96
9-939	Bis(2-chloroethyl)ether		< 0.005	< 0.005	<0.005	87
9-939	1,4-Dichlorobenzene		< 0.005	< 0.005	<0.005	88
9-939	Hexachloroethane		< 0.005	< 0.005	<0.005	87
9-939	Nitrobenzene		< 0.005	< 0.005	<0.005	80
9-939	Naphthalene		< 0.005	<0.005	<0.005	90
9-939	2-Chloronaphthylene		< 0.005	<0.005	<0.005	82
9-939	2,4-Dinitrotoluene		<0.005	<0.005	<0.005	87
9-939	Phenanthracene		< 0.005	<0.005	<0.005	93
9-939	Di-n-butyl phthalate		< 0.005	<0.005	<0.005	102
9-939	Bis(2-ethylhexyl)phthalate		< 0.005	<0.005	<0.005	91
9-939	Di-n-octylphthalate		< 0.005	<0.005	<0.005	82
9-939	PCB ug/l		< 0.25	< 0.25	<0.25	90
9-939	Aldrin ug/l		< 0.04	< 0.04	<0.04	84
9-939	p,p'-DDE ug/l					89
9-939	p,p'-DDT ug/l		< 0.11	< 0.11	<0.11	87
9-939	Endosulfan I ug/l		< 0.14	< 0.14	<0.14	96
9-939	Thiram		< 0.11	< 0.11	<0.11	71

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Results A	Results B	Spike Recovery %
9-939	2-Chlorophenol		0.005	0.005	0.005	102
9-939	2-Nitrophenol		0.005	0.005	0.005	110
9-939	2,4-Dinitrophenol		0.015	0.015	0.015	96

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-944	Chloroform		<0.004	<0.004	<0.004	90
9-944	Chloroethane		<0.002	<0.002	<0.002	96
9-944	Methylene chloride		<0.004	<0.004	<0.004	110
9-944	1,1,1-Trichloroethane		<0.002	<0.002	<0.002	88
9-944	Trichloroethene		<0.002	<0.002	<0.002	90
9-944	Chloroebenzene		<0.002	<0.002	<0.002	95
9-944	1,2-Dichloroebenzene		<0.0002	<0.0002	<0.0002	86
9-944	Toluene		<0.0004	<0.0004	<0.0004	94
9-944	Benzene		<0.0002	<0.0002	<0.0002	89
9-944	Ethylbenzene		<0.0002	<0.0002	<0.0002	90

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-945	PCB ug/l		<0.25	<0.25	<0.25	83
9-945	Aldrin ug/l		<0.04	<0.04	<0.04	87
9-945	p,p'-DDE ug/l		<0.08	<0.08	<0.08	102
9-945	p,p'-DDT ug/l		<0.11	<0.11	<0.11	94
9-945	Endosulfan I ug/l		<0.14	<0.14	<0.14	88
9-945	Thiram		<0.01	<0.01	<0.01	77
9-945	2-Chlorphenol		<0.0005	<0.0005	<0.0005	110
9-945	2-Nitrophenol		<0.0005	<0.0005	<0.0005	120
9-945	2,4-Dinitrophenol		<0.015	<0.015	<0.015	95
9-945	2,4-Dichlorphenol		<0.003	<0.003	<0.003	118
9-945	2,4,6-Trichlorophenol		<0.006	<0.006	<0.006	115
9-945	4-Chloro-3-methylpheno		<0.004	<0.004	<0.004	97
9-945	Pentachlorphenol		<0.007	<0.007	<0.007	120
9-945	Bis(2-Chloroethyl)ether		<0.005	<0.005	<0.005	82
9-945	1,4-Dichlorobenzene		<0.005	<0.005	<0.005	80
9-945	Hexachloroethane		<0.005	<0.005	<0.005	89
9-945	Nitrobenzene		<0.005	<0.005	<0.005	91
9-945	Naphthalene		<0.005	<0.005	<0.005	94
9-945	2-Chloronaphthylene		<0.005	<0.005	<0.005	88
9-945	2,4-Dinitrotoluene		<0.005	<0.005	<0.005	85
9-945	Phenanthracene		<0.005	<0.005	<0.005	92

Sample I.D.	Parameter	Method Standard Recovery %	Blank	Duplicate Results A	Duplicate Results B	Spike Recovery %
9-945	Di-n-butyl phthalate		< 0.005	<0.005	<0.005	98
9-945	Bis(2-ethylhexyl) phthalate		< 0.005	<0.005	<0.005	103
9-945	Di-n-octylphthalate		< 0.005	<0.005	<0.005	95
9-945	TOC	110	< 2.0	110	100	79

SULFIDE DATA

Lab No.	Dilution	ml of 0.025 N KI	ml of Titrant 0.025 N	mg/kg Sulfide
9-508	38.5g/200 ml	1 ml	1 ml	< 0.5
9=508 Dup	40g/200 ml	1 ml	1 ml	< 0.5
9-508+1.5 mg/kg	40g/200 ml	1 ml	0.85 ml	1.5 100%
9-512	39.5g/200 ml	1 ml	1 ml	< 0.5
9-512 Dup	40.0g/200 ml	1 ml	1 ml	< 0.5
9-512+1.5 mg/kg	39.89g/200 ml	1 ml	0.85 ml	1.5 100%
9=504	38.0g/200 ml	1 ml	1 ml	< 0.5
9-504 Dup	37.0g/200 ml	1 ml	1 ml	< 0.5
9-504+7.4 mg/kg	8.15g/200 ml	1 ml	0.87 ml	6.38 86%

FURNACE DATA

Cadmium			Chrome		
Sample #	+Addition	Peak Heights	Sample #	+Addition	Peak Hei
9-939	+0 ug	2,3,2,3	9-939	+0 ug	11,12
	+2.5 ug	36,35		+5 ug	22,24
	+5.0 ug	58,56		+10 ug	42,47
9-940	+0	5,3	9-940	+0	7,6
	+2.5	34,30		+5	26,26
	+5.0	57,53		+10	45,49
9-941	+0	6,3	9-941	+0	20,2 17
	+2.5	36,34		+5	39,39,4
	+5.0	58,58		+10	55,58
9-942	+0	1,2	9-942	+0	8,11,8
	+2.5	36,36		+5	24,26
	+5.0	74,64		+10	52,55,5
9-943	+0	3,4	9-943	+0	6,6,5
	+2.5	30,31		+5	32,30
	+5.0	80,65		+10	51,54
9-944	+0	4,4	9-944	+0	5,5
	+2.5	39,35		+5	28,
	+5.0	57,58		+10	51,54
9-945	+0	3,4	9-945	+0	4,5
	+2.5	49,48		+5	25,27
	+5.0	76,70		+10	50,47

HYDRIDE GENERATION DATA FOR SELENIUM

Calibration Standard		Absorbance (x1000)
0	ug/l	8,8
4	ug/l	63,61
7	ug/l	96,89
10	ug/l	128,130

Sample #	Absorbance (x1000)
9-939	10
9-940	14
9-941	8
9-942	16
9-943	8
9-944-1	14
9-944-2	14
9-944 +(0.004)	71
9-945	7
MS (0.007)	103
BL	11

QUANTITATION SUMMARY

Customer : CANTON LABORATORIES 11-06-1984

SL#10718 11 gr extracted of sample 9-699

COMPOUND	CONCENTRATION Milligrams/Kilogram	D.L.
ACENAPHTHENE	N.D.	0.022
ACENAPHTHYLENE	N.D.	0.022
ANTHRACENE	0.084	0.022
BENZIDINE	N.D.	0.022
BENZO(a)ANTHRACENE	N.D.	0.022
BENZO(a)PYRENE	0.074	0.043
3,4-BENZOFLUORANTHENE	N.D.	0.043
BENZO(ghi)PERYLENE	N.D.	0.065
BENZO(k)FLUORANTHENE	N.D.	0.043
bis(2-CHLOROETHOXY)METHANE	N.D.	0.022
bis(2-CHLOROETHYL)ETHER	N.D.	0.022
bis(2-CHLOROISOPROPYL)ETHER	N.D.	0.022
bis(2-ETHYLHEXYL)PHTHALATE	0.249	0.022
4-BROMOPHENYL PHENYL ETHER	N.D.	0.022
BUTYL BENZYL PHTHALATE	N.D.	0.022
2-CHLORONAPHTHALENE	N.D.	0.022
4-CHLOROPHENYL PHENYL ETHER	N.D.	0.022
CHRYSENE	N.D.	0.022
DIBENZO(a,h)ANTHRACENE	N.D.	0.065
1,2-DICHLOROBENZENE	N.D.	0.022
1,3-DICHLOROBENZENE	N.D.	0.022
1,4-DICHLOROBENZENE	N.D.	0.022
3,3'-DICHLOROBENZIDINE	N.D.	0.054
DIETHYL PHTHALATE	N.D.	0.022
DIMETHYL PHTHALATE	N.D.	0.022
DI-n-BUTYL PHTHALATE	N.D.	0.022
2,4-DINITROTOLUENE	N.D.	0.108
2,6-DINITROTOLUENE	N.D.	0.108
DI-n-OCTYL PHTHALATE	N.D.	0.022
1,2-DIPHENYLHYDRAZINE	N.D.	0.022
FLUORANTHENE	N.D.	0.022
FLUORENE	N.D.	0.022
HEXACHLOROBENZENE	N.D.	0.022
HEXACHLOROBUTADIENE	N.D.	0.022
HEXACHLOROCYCLOPENTADIENE	N.D.	0.022
HEXACHLOROETHANE	0.676	0.022
INDENO(123-cd)PYRENE	N.D.	0.054
ISOPHORONE	N.D.	0.043
NAPHTHALENE	0.057	0.022
NITROBENZENE	N.D.	0.022
N-NITROSO-DIMETHYLAMINE	N.D.	0.022
N-NITROSO-DI-n-PROPYLAMINE	N.D.	0.043
N-NITROSO-DIPHENYLAMINE	N.D.	0.022
PHENANTHRENE	0.103	0.022
PYRENE	0.163	0.022
1,2,4-TRICHLOROBENZENE	N.D.	0.022
THIRAM	N.D.	0.022
TOTAL POLLUTANTS	1.406	

T=TIC
10718
9-699

APPENDIX H

- RECORD OF MONITORING WELLS
- SAMPLE SLUG TEST DATA WITH HYDRAULIC CONDUCTIVITY AND TRANSMISSIVTY CALCULATIONS
- SUMMARY OF CALCULATED HYDRAULIC CONDUCTIVITY AND TRANSMISSIVITY VALUES

KMA
• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES, INC
3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

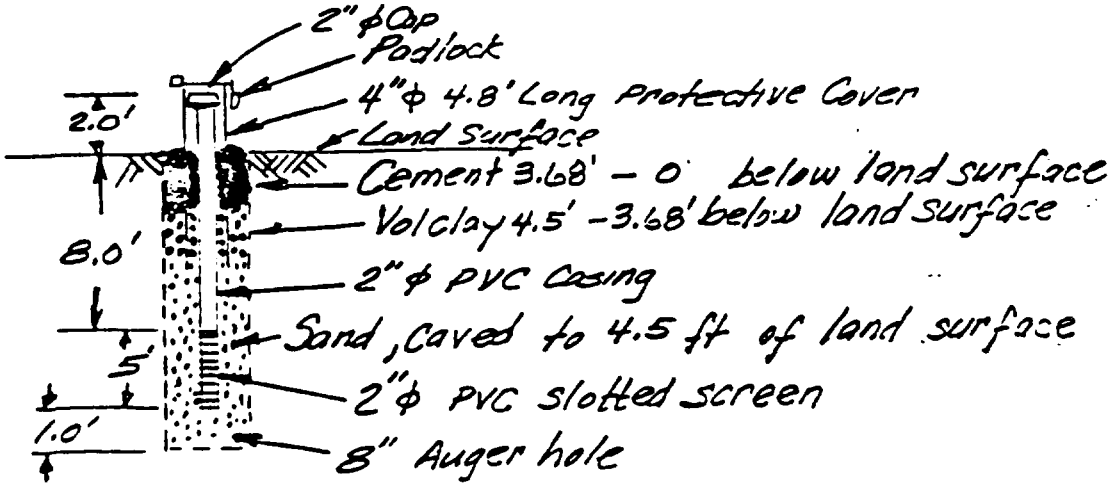
Project No. S94-3224
Well File No.
Owner's Well No. 1
Client Johns-Manville
Date Sept. 19, 1984
2:15-4:05 pm

RECORD OF WELL

1. LOCATION: State Illinois County: Lake Township: Benton
   Distances Grid: 7,526.322 North, SE ¼ SW ¼ SE ¼ Sec. 10 T. 45 N. R. 12 E.
   11,804.300 East
2. OWNER John-Manville Address Waukegan, Illinois
   CONTRACTOR American Geotechnical* Address Novi, Michigan
3. ELEVATION of top of well: 591.16 ft. (above, the level of: mean sea level Repr.)
4. TYPE of well: Monitoring Date Constructed Sept 19, 84 Driller R&R Near
5. DEPTH of well: 13.0 ft. meas Depth to bedrock ft. Formation
6. DIAMETER: 2 in.
   CASING: kind PVC ; size 2 ; length 10.0 ft. between +2.0 & 8.0 ft.
   kind ; size ; length ft. between & ft.
   SCREEN: make and material PVC slotted ; length 5.0 ft.; Dia. 2 in.
   size of openings 8 slot depth to (packer or top of slots) ft.
7. WATER LEVEL: 6.35 ft. (below) Top of Casing Meas'd. Sept. 19, 1984
8. PUMP: make and serial number Cap gpm @ ft. (head)
   power ; motor h.p. ; length of column & shaft ft. dia. of column & shaft in.
   bowls ft.; stages; tail pipe ft.; strainer ; lubrication
   YIELD: original yield ; pumped gpm for hours with drawdown
10. LOG and REMARKS: * Hydrogeologic Engineering, Inc.

0	-	2'	Sand, fine
2	-	4'	Cinders, pipe fragments
4	-	14'	Sand, fine to med., black cleaning to tan with depth

Pumped 108 gallons of water during development



KMH

• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES, INC

3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

Well File No. _____

Owner's Well No. 2

Client Johns-Manville

Date Sept 19, 1984
8:00-9:08 am

RECORD OF WELL

1. LOCATION: State Illinois County: Lake Township: Benton

Distances Grid: 7,629.600 North, SW ¼ SW ¼ SW ¼ Sec 11 T 45 N, R 12 E
13,257.249 East

2. OWNER Johns-Manville Address Waukegan, Illinois

CONTRACTOR American Geotechnical* Address Novi, Michigan

3. ELEVATION of top of well: 587.88 ft. (above, the level of mean sea level Repr'd.)

4. TYPE of well: Monitoring Date Constructed Sept 19, 84 Driller R&R Near

5. DEPTH of well: 13.0 ft. meas. Depth to bedrock _____ ft. Formation _____

6. DIAMETER: 2 in.

CASING: kind PVC ; size 2 ; length 10.0 ft. between +2 & 8 ft.

kind _____ ; size _____ ; length _____ ft. between _____ & _____ ft.

SCREEN: make and material PVC slotted ; length 5.0 ft.; Dia 2 in.

size of openings 8 slot ; depth to (packer or top of slots) _____ ft.

7. WATER LEVEL: 5.66 ft. below Top of Casing Repr'd. Sept 19, 1984

8. PUMP: make and serial number _____ Cap _____ gpm @ _____ ft. (head)

power _____; motor h.p. _____; length of column & shaft _____ ft. dia. of column & shaft _____ in.

bowls _____ ft.; _____ stages; tail pipe _____ ft.; strainer _____; lubrication _____

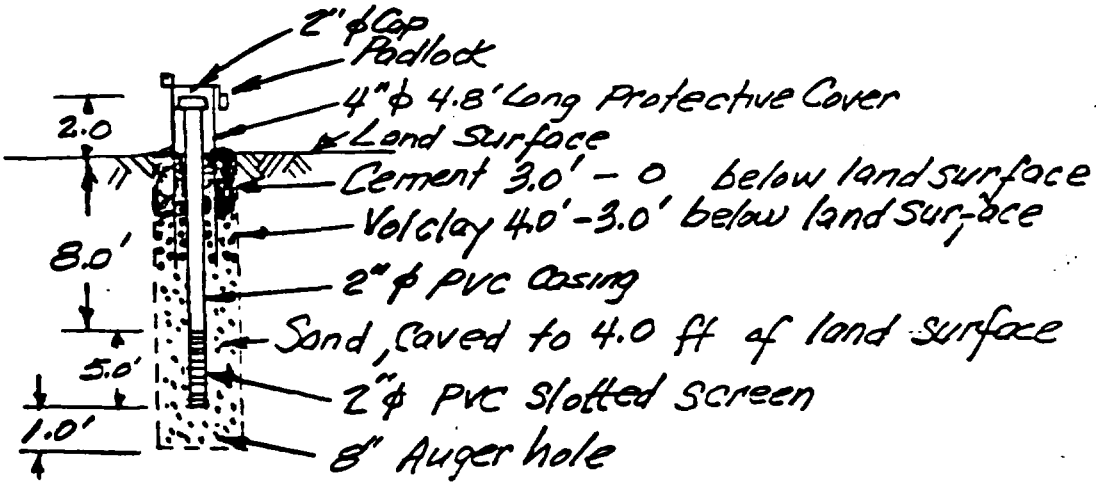
9. YIELD: original yield _____; pumped _____ gpm for _____ hours with _____ drawdown

10. LOG and REMARKS: * & Hydrogeologic Engineers, Inc.

0 - 2.5' Sand, fine to coares, gravelly, beach cobbles

2.5 - 14' Sand, fine to med., gravelly, waterbearing

Pumped 105 gallons of water during development



KMA
• ENGINEERS • CONSULTANTS • PLANNERS •
KUMAR MALHOTRA & ASSOCIATES, INC
3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

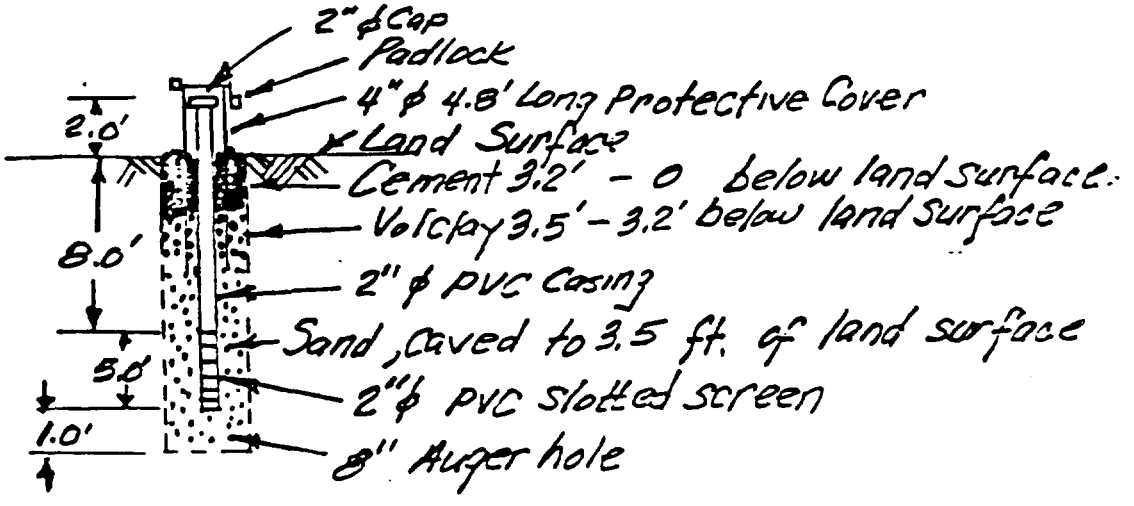
Project No. S94-3224
Well File No.
Owner's Well No. 3
Client Johns-Manville
Date Sept 19, 1984
9:15-10:20 am

RECORD OF WELL

1. LOCATION: State Illinois County: Lake Township: Benton
   Distances Grid: 8,604.949 North SW ¼ NW ¼ SW ¼ Sec. 11 T. 45 N, R. 12 E
   13,276.405 East
2. OWNER Johns-Manville Address Waukegan, Illinois
   CONTRACTOR American Geotechnical * Address Novi, Michigan
3. ELEVATION of top of well: 588.92 ft. (, below) the level of: mean sea level Repr'd.)
4. TYPE of well: Monitoring Date Constructed Sept19,84 Driller R&R Near
5. DEPTH of well: 13.0 ft. meas Depth to bedrock ft. Formation
6. DIAMETER: 2 in.
   CASING: kind PVC ; size 2 ; length 10 ft. between +2.0 & 8.0 ft.
   kind ; size ; length ft. between & ft.
   SCREEN: make and material PVC slotted ; length 5.0 ft.; Dia. 2 in.
   size of openings 8 slot ; depth to (packer or top of slots) ft.
7. WATER LEVEL: 6.28 ft. below) Top of casing Meas'd. Sept 19, 1984
8. PUMP: make and serial number Cap gpm @ ft. (head)
   power ; motor h.p. ; length of column & shaft ft. dia. of column & shaft in.
   bowls ft.; stages; tail pipe ft.; strainer ; lubrication
9. YIELD: original yield ; pumped gpm for hours with drawdown
10. LOG and REMARKS: * Hydrogeologic Engineers, Inc.

0 - 3' Sand , fine to coarse, gravelly, fine
3 - 14' Sand, fine to coarse, gravelly, fine, waterbearing

Pumped 120 gallons of water during development



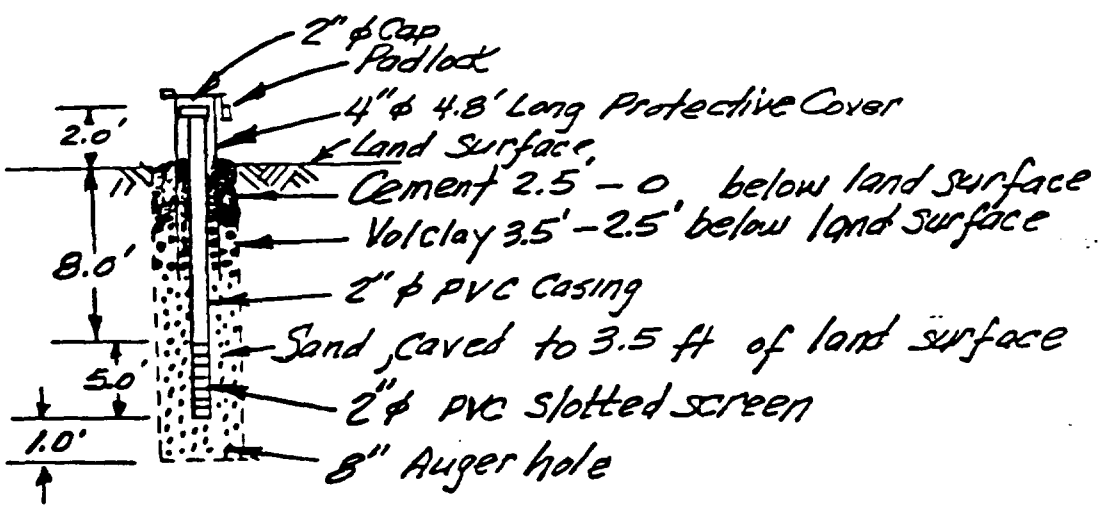
KMA
• ENGINEERS • CONSULTANTS • PLANNERS •
KUMAR MALHOTRA & ASSOCIATES, INC.
3000 East Bell Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

Project No.
Well File No.
Owner's Well No. 4
Client Johns-Manville
Date Sept 18, 1984
12:50-2:07 pm

RECORD OF WELL

1. LOCATION: State Illinois County: Lake Township: Benton
   Distances Grid: 9,757.456 North, 13,271.289 East; NW ¼ NW ¼ SE ¼ Sec. 11 T. 45 N R. 12 E
2. OWNER Johns-Manville Address Waukegan, Illinois
   CONTRACTOR American Geotechnical &* Address Novi, Michigan
3. ELEVATION of top of well: 587.20 ft. (above, the level of mean sea level) Rept'd.
4. TYPE of well: Monitoring Date Constructed Sept 19,84 Driller R&R Near
5. DEPTH of well: 13.0 ft. meas Depth to bedrock ft. Formation
6. DIAMETER: 2 in.
   CASING: kind PVC ; size 2 ; length 10 ft. between +2.0 & 8.0 ft.
   kind ; size ; length ft. between & ft.
   SCREEN: make and material PVC slotted ; length 5.0 ft.; Dia. 2 in.
   size of openings 8 slot depth to (packer or top of slots) ft.
7. WATER LEVEL: 4.58 ft. (Meas'd. below) Top of casing Sept 19,1984
8. PUMP: make and serial number Cap gpm @ ft. (head)
   power ; motor h.p ; length of column & shaft ft. dia. of column & shaft in.
   bowls ft.; stages; tail pipe ft.; strainer ; lubrication
9. YIELD: original yield ; pumped gpm for hours with drawdown
10. LOG and REMARKS: * Hydrogeologic Engineers, Inc.
    0. - 3' Sand, fine to coarse, gravelly
    3 - 14' Sand, fine to coarse, waterbearing

    Pumped 90 gallons of water during development



KMA
• ENGINEERS • CONSULTANTS • PLANNERS •
KUMAR MALHOTRA & ASSOCIATES, INC
3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

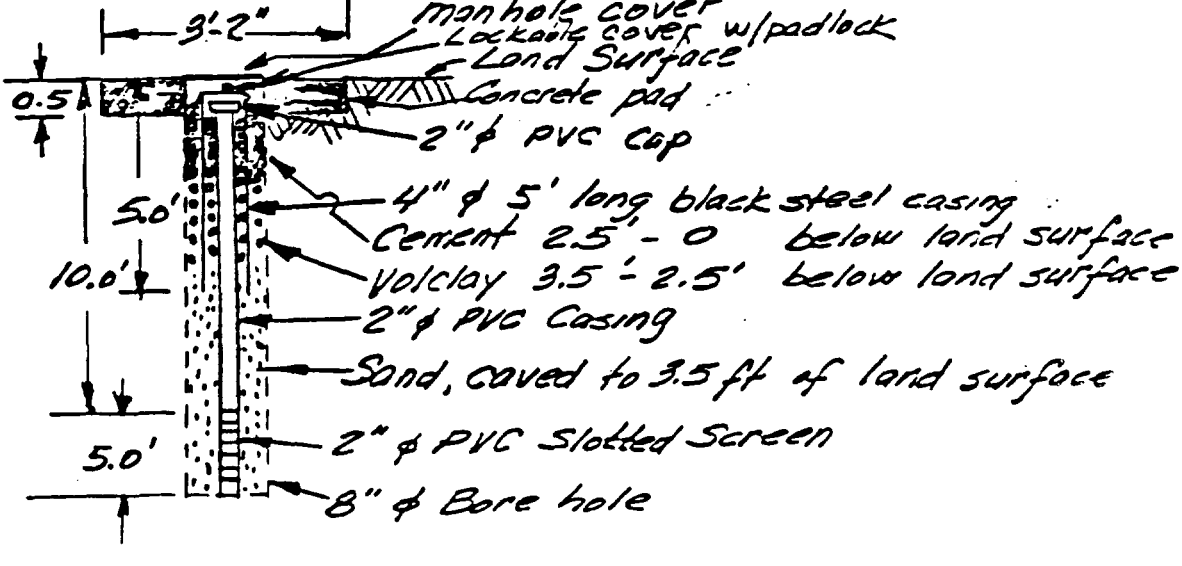
Project No. 594-3224
Well File No.
Owner's Well No. 5
Client Johns-Manville
Date Sept 19, 1984
2:45-5:00 pm

RECORD OF WELL

1. LOCATION: State Illinois County: Lake Township: Benton
   Distances Grid: 8,869.430 North SE ¼ NW ¼ SW ¼ Sec. 10 T. 45 N R. 12 E
   8,463.178 East
2. OWNER Johns-Manville Address Waukegan, Illinois
   CONTRACTOR American Geotechnical &* Address Novi, Michigan
3. ELEVATION of top of well: 588.00 ft. (above, the level of: mean sea level Rep'd.)
   TYPE of well: Monitoring Date Constructed Sept 19, 84 Driller R&R Near
5. DEPTH of well: 15.0 ft. meas. Depth to bedrock ft. Formation
6. DIAMETER: 2 in.
   CASING: kind PVC ; size 2 ; length 10 ft. between 0 & 10 ft.
   kind ; size ; length ft. between & ft.
   SCREEN: make and material PVC slotted ; length 5.0 ft.; Dia 2 in.
   size of openings 8 slot depth to (packer or top of slots) ft.
7. WATER LEVEL: 4.71 ft. (above, below) Top of casing Meas'd. Sept 19, 1984
8. PUMP: make and serial number Cap gpm @ ft. (head)
   power ; motor h.p ; length of column & shaft ft. dia. of column & shaft in.
   bowls ft.; stages; tail pipe ft.; strainer ; lubrication
   YIELD: original yield ; pumped gpm for hours with drawdown
10. LOG and REMARKS: * Hydrogeologic Engineers, Inc.

0 - 4' Cinders
4 - 5' Sand, fine, tan
5 - 15" Sand, fine to med., tan, waterbearing

Pumped 90 gallons of water during development

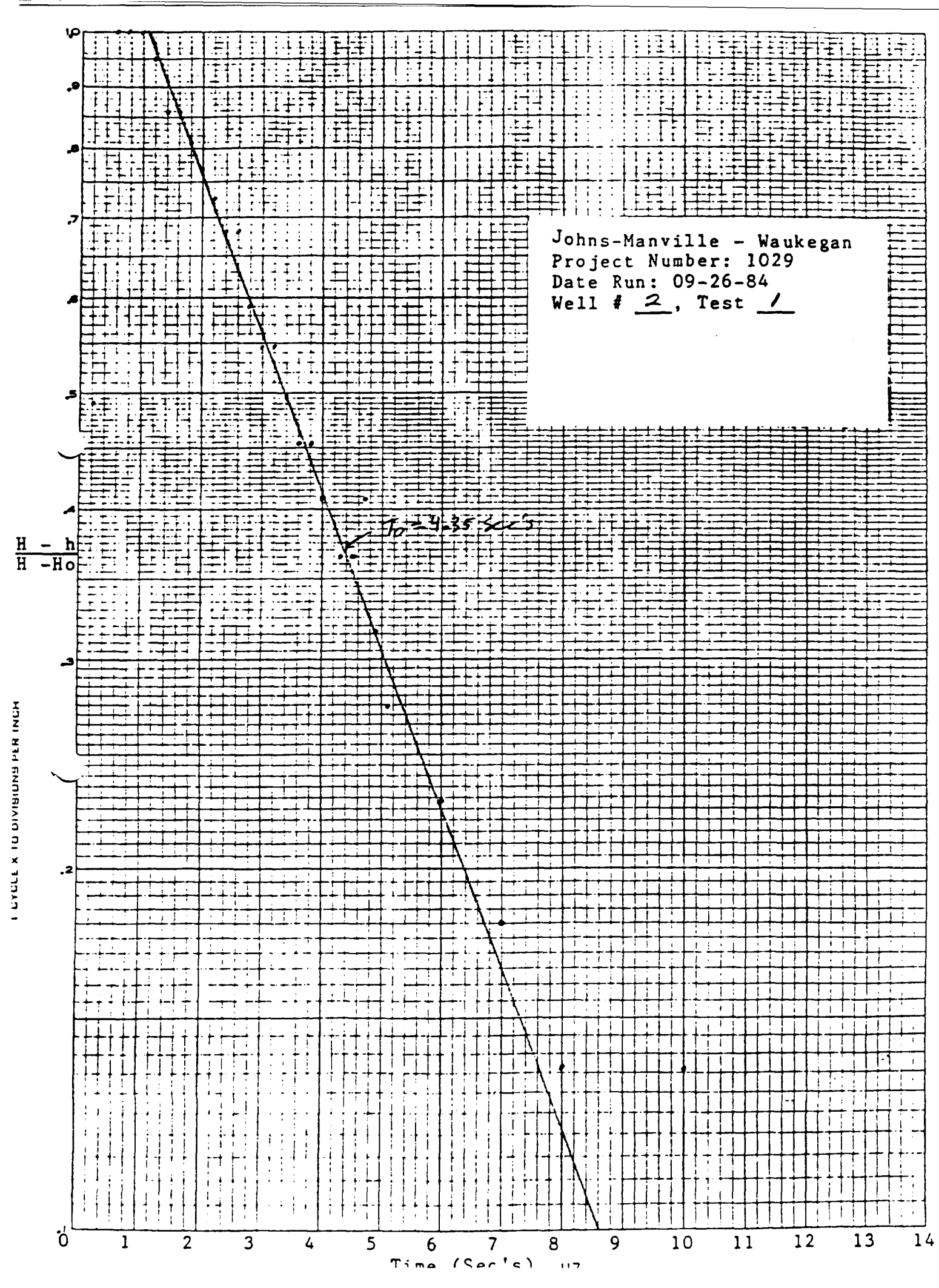


Date: 09-26-84
Client: Johns-Manville - Waukegan
Project Number: 1029

SLUG TEST DATA
Hvorslev Procedure

Well Identification: Well 2, Test 1
Analysis by: LMA - HWD
Static Water Datum 8.92 ft.(271.8816 cm)
Initial Water Level + 2.5 ft.(76.2 cm)
Casing Radius 1 in.(2.54 cm)
Cable Radius .1875 in.(.47625 cm)
Screen Length 5 ft.(152.4 cm)
Screen Radius 1 in.(2.54 cm)
Well Radius Squared - Cable Radius Squared .9648438 sq.in.(6.224786 sq.cm)

Time	Reading	Remaining Recovery	Corrected Recovery	H -h / H - HO
Sec.	feet	feet	feet	
.6	11.41	2.49	2.5	1
.8	11.41	2.49	2.5	1
1	11.41	2.49	2.5	1
1.2	11.29	2.37	2.379518	.9518073
1.4	11.07	2.15	2.158635	.8634538
1.6	11.07	2.15	2.158635	.8634538
1.8	10.96	2.04	2.048193	.8192772
2	10.84	1.92	1.927711	.7710845
2.2	10.73	1.81	1.817269	.7269075
2.4	10.62	1.7	1.706827	.682731
2.6	10.62	1.7	1.706827	.682731
2.8	10.39	1.47	1.475904	.5903616
3	10.28	1.36	1.365462	.5461847
3.2	10.28	1.36	1.365462	.5461847
3.4	10.16	1.24	1.24498	.497992
3.6	10.05	1.13	1.134538	.4538154
3.8	10.05	1.13	1.134538	.4538154
4	9.939999	1.02	1.024096	.4096384
4.3	9.83	.9099999	.9136546	.3654618
4.5	9.83	.9099999	.9136546	.3654618
4.7	9.939999	1.02	1.024096	.4096384
4.9	9.71	.79	.7931727	.3172691
5.1	9.600001	.6800003	.6827313	.2730925
6	9.49	.5699997	.572289	.2289156
7	9.37	.4499998	.4518071	.1807228
8	9.26	.3400002	.3413656	.1365463
9	9.149999	.2299996	.2309233	.0923693
10	9.26	.3400002	.3413656	.1365463
11	9.149999	.2299996	.2309233	.0923693
12	9.03	.1099997	.1104414	4.417657E-02
13	9.149999	.2299996	.2309233	.0923693


Johns-Manville - Waukegan
Project Number: 1029
Date Run: 09-26-84
Well # 2, Test 1
T10 = 4.35 sec's
H - h / H - Ho
1 CYCLE X 10 DIVISIONS PER INCH
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time (Sec's)

Date: 09-26-84
Client: Johns-Manville - Waukegan
Project Number: 1029

SLUG TEST DATA
Hvorslev Procedure

Well Identification: Well 2, Test 1
Analysis by: LMA - HWD
Static Water Datum 8.92 ft.(271.8816 cm)
Initial Water Level + 2.5 ft.(76.2 cm)
Casing Radius 1 in.(2.54 cm)
Cable Radius .1875 in.(.47625 cm)
Screen Length 5 ft.(152.4 cm)
Screen Radius 1 in.(2.54 cm)
Well Radius Squared - Cable Radius Squared .9648438 sq.in.(6.224786 sq.cm)

$$K = \frac{r^2 x \ln(LS/RS)}{2 \times LS \times T0}$$

Where:
- r^2 = Well Radius Squared - Cable Radius Squared = .9648438 sq.in.
- LS = Screen Length = 5 feet
- RS = Screen Radius = 1 inches
- T0 = Time for Recovery at Initial Rate = 4.35 sec's
- K = Permeability

K = 407.7043 Gal/day-sq.ft.(1.922227E-02 cm/sec)

$T = K \times M$

Where:
- M = Aquifer Thickness = 37 feet
- T = Transmissivity

T = 15085.06 Gal/day-ft.(187.3011 m^2/day)

SUMMARY OF HYDRAULIC CONDUCTIVITY AND TRANSMISSIVITY VALUES*

Well No.		Test 1	Test 2	Test 3	Test 4
1	Hydraulic Conductivity	316.7	344.4	-	443.4
	Transmissivity	11,401	12,397	-	15,962
2	Hydraulic Conductivity	407.7	403.1	394.1	407.7
	Transmissivity	15,085	14,913	14,582	15,085
3	Hydraulic Conductivity	537.4	554.2	545.7	529.4
	Transmissivity	19,885	20,506	20,190	19,588
4	Hydraulic Conductivity	151.6	211.1	373.4	313.9
	Transmissivity	5,608	7,811	13,814	11,614
5	Hydraulic Conductivity	369.5	394.1	443.4	466.7
	Transmissivity	7,907	8,434	9,488	9,988

*Hydraulic Conductivity Values are in Gal/day - sq. ft.

Transmissivity Values are in Gal/day - ft.
(Aquifer Thickness used was 21.4 ft. at Well 5 and 36 to 37 ft. at other well locations)

MISCELLANEOUS DATA

APPENDIX I

"CONSENT ORDER" BETWEEN

JOHNS-MANVILLE AND USEPA

DATED JUNE 14, 1984

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V

IN THE MATTER OF:	)	
	)	
JOHNS-MANVILLE SALES CORPORATION, WAUKEGAN, ILLINOIS	)	U.S.E.P.A. Docket No.
	)	
Proceeding Under Section 106(a) of the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §9606(a) (1980)	)	

ADMINISTRATIVE ORDER BY CONSENT

The signatories to this Administrative Order By Consent ("Consent Order"), by their respective attorneys, having agreed to the entry of this Consent Order,

THEREFORE, It is Ordered, Adjudged, and Decreed that:

I. JURISDICTION

This Consent Order is issued pursuant to the authority vested in the President of the United States by Section 106(a) of the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"), 42 U.S.C. §9606(a), and delegated to the Administrator of the United States Environmental Protection Agency ("USEPA") on August 14, 1981 by Executive Order 12316, 46 Fed. Reg. 42237 (Aug. 20, 1981), who duly

redelegated the authority to the Regional Administrator of Region V, USEPA on April 1, 1983.

II. DESCRIPTION OF SITE

Johns-Manville Sales Corporation ("Johns-Manville") owns and operates a facility on Greenwood Avenue in Waukegan, Illinois ("Waukegan facility"). The Waukegan facility was constructed beginning in 1919 and ending in 1923. Since it began operations, the Waukegan facility has produced a variety of building materials comprised of a variety of substances. In operating, waste was and is generated, consisting of such things as trim and rejects from the finished products and of materials unused in the manufacturing process. Included among the waste generated at the Waukegan facility over the years are hazardous substances as defined by Section 101(14) of CERCLA, 42 U.S.C. §9601(14), and other wastes, including asbestos, chromium, lead, xylene and thiram.

Much of the waste has been disposed of in the Waukegan facility's onsite disposal area ("Disposal Area"). The Disposal Area covers approximately 120 acres of land that was formerly marsh land. The Disposal Area presently consists of four general waste disposal areas - the friable asbestos disposal pit, the scrap disposal area, the wet waste basin system composed of a series of settling basins, and the sludge disposal area.

While a precise volume of waste disposed at the Disposal Area cannot be ascertained due to the long history of operations and lack of records for the earlier years, it is estimated that nearly 600,000 tons of asbestos-containing waste and raw asbestos waste have been disposed of at the Disposal Area.

The Disposal Area is bordered on the west by the buildings erected at the Waukegan facility, on the south by Commonwealth Edison Company's Waukegan Station, on the east by Lake Michigan and on the north by the Illinois Beach State Park.

In December, 1973 and April, 1982, contractors for USEPA collected air monitoring data to determine the impact of asbestos disposal practices at the Waukegan facility on the ambient air. Based on the results of the air monitoring studies and the potential for surface and ground water contamination, the Disposal Area was included, over the objections of Johns-Manville, in the National Priorities List promulgated by USEPA on September 8, 1983 as Appendix B to the National Oil and Hazardous Substances Contingency Plan, 48 Fed. Reg. 40658 (Sept. 8, 1983), and is a candidate for response action by USEPA under CERCLA.

The Regional Administrator, USEPA, has determined but Johns-Manville does not acknowledge that: (1) the Waukegan facility is a "facility" as defined in Section 101(9) of

CERCLA; (2) Johns-Manville is a "person" as that term is defined in Section 101(21) of CERCLA; (3) "hazardous substances" as defined by Section 101(14) of CERCLA have been disposed at the Waukegan facility; (4) the release and threatened release of hazardous substances into the air, groundwater and surface water adjacent to the Waukegan facility constitutes a "release or threat of release" as that term is defined in Section 101(22) of CERCLA, which may present an imminent and substantial endangerment to public health or welfare or the environment; (5) Johns-Manville is a "responsible person" within the meaning of Section 107 of CERCLA; and (6) the actions to be taken pursuant to this Consent Order are reasonable and necessary to protect the public health or welfare and the environment.

A reasonable time period for beginning and completing the actions required by this Consent Order has been provided for, and Johns-Manville has agreed to undertake the actions requested by the USEPA in this Consent Order. The Signatories agree that the Work to be undertaken pursuant to this Consent Order is appropriate for determining the appropriate extent of response authorized by CERCLA and is not inconsistent with the National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300 (1983).

III. Signatories

This Consent Order shall apply to and be binding upon the Signatories Johns-Manville and USEPA, their officials, officers, directors, agents, principals, servants, employees, successors, and assigns, and upon all persons, firms, and corporations acting under or for the parties, including subsidiaries and divisions of Johns-Manville. Each undersigned representative of a Signatory to this Consent Order certifies that he or she is fully authorized to enter into the terms and conditions of this Consent Order and to legally bind such Signatory to this document.

IV. WORK TO BE PERFORMED

A. The following Work shall be performed by Johns-Manville at the Disposal Area:

1. Initial Remedial Measures: Within 45 days of the effective date of this Consent Order, Johns-Manville shall install along the perimeter of the Disposal Area, if they are not already in place, warning signs which satisfy the requirements of 40 C.F.R. §61.25 (1983). These warning signs will be displayed at the locations identified in Exhibit 2C.

2. Water Balance Study: Johns-Manville has undertaken a study of the water used in its operation of the Waukegan

facility in an effort to determine whether, and if so where, there is any loss of process waste water to the environment ("Water Balance Study"). The Water Balance Study will be considered, along with the Remedial Investigation/Feasibility Study which is to be performed, in developing, screening, and selecting pursuant to the applicable provisions of 40 C.F.R. §300.68 (1983) the Remedial Action Alternative for the Disposal Area. Johns-Manville shall complete the Water Balance Study by April 17, 1984 and shall submit to USEPA a final report concerning the means by which the Water Balance Study was undertaken and the conclusions drawn from it.

3. Remedial Investigation/Feasibility Study: Johns-Manville shall conduct a Remedial Investigation ("RI") and Feasibility Study ("FS") at the Disposal Area which will implement the following tasks:

(a) An air monitoring study to determine the extent to which airborne asbestos concentrations are elevated at the Disposal Area compared to background levels and the exposure potential for residents of surrounding areas as described in Exhibit 1 attached hereto.

(b) Johns-Manville has prepared the Specifications for Geotechnical and Hydrological Investigation attached hereto as Ex-

hibit 2, and the drawings described in paragraph 1.1 of Exhibit 2 and attached hereto as Exhibits 2A through 2C. These documents were submitted to USEPA for approval on or about February 20, 1984. Once the documents are approved by USEPA, the work described therein will commence.

(c) Upon completion of the work described in paragraphs (a) and (b) above, Johns-Manville shall prepare a RI report, as described generally in paragraph A of Exhibit 3 attached hereto. The RI report shall be submitted to USEPA for approval within 180 days of the effective date of this Consent Order.

(d) Upon approval of the RI report, Johns-Manville will undertake an "Alternative Remedial Actions Evaluation," as described generally in paragraph B of Exhibit 3 attached hereto.

(e) Johns-Manville will compile and describe in a FS report the methods, results, and conclusions of the Alternative Remedial Actions Evaluation undertaken. The FS report shall include generally the items described

in paragraph C of Exhibit 3 attached hereto and shall recommend a selected remedial alternative ("Recommended Remedial Action Alternative"), as described by 40 C.F.R. §300.68(j) (1983). This recommendation shall include appropriate provisions for deed notice and future maintenance of the property. The FS report shall be submitted to USEPA for approval within 90 days of approval by USEPA of the RI report. Approval of the RI or FS reports may depend upon the gathering of additional data or further engineering evaluations. Where additional data or evaluations are requested, USEPA shall so notify Johns-Manville and provide Johns-Manville with a time schedule for submission of such data. Johns-Manville shall thereafter gather the data or proceed in accordance with the dispute resolution provisions of paragraph V of this Consent Order.

(f) USEPA and Johns-Manville agree to promptly and in good faith enter into negotiations for the purpose of reaching agreement

on the Recommended Remedial Action Alternative as described by 40 C.F.R. §300.68(j)(1983) to be proposed to be undertaken by Johns-Manville at the Disposal Area. Any agreement reached by USEPA and Johns-Manville will be embodied in an administrative order by consent subject to appropriate opportunity for public comment and approval.

B. Exhibits 1, 2, 2A through 2C, and 3 attached hereto and documents, reports, and schedules developed pursuant to this Consent Order are integral parts of this Consent Order and are hereby incorporated by reference as though set forth verbatim.

C. The RI/FS shall be conducted in conformance with and shall be evaluated by USEPA for approval in accordance with the applicable provisions of 40 C.F.R. §300.68 (1983).

D. USEPA certifies that the Work approved by USEPA is consistent with the National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300 (1983).

V. COMMENCEMENT AND COMPLETION OF WORK AND PROGRESS REPORTS

A. Subject to obtaining any necessary permits, Johns-Manville shall commence the Work as provided in paragraph IV of this Consent Order. The Work shall be completed in accord-

ance with the standards, specifications, and the schedule of completion contained in paragraph IV of this Consent Order. Johns-Manville shall obtain all necessary permits as expeditiously as possible.

B. Johns-Manville shall provide to USEPA written progress reports which describe the actions which have been taken toward achieving compliance with this Consent Order during the previous month as well as actions which are scheduled for the next month. These progress reports are to be submitted to USEPA by the tenth day of every month following the effective date of this Consent Order, unless otherwise agreed to by the Signatories.

C. 1. Johns-Manville shall submit to USEPA for approval the Work upon its completion according to the schedule contained in paragraph IV of this Consent Order. USEPA shall review the Work and indicate its approval or disapproval of the Work within thirty days of receipt of the Work submitted.

2. In the event the Work is disapproved in whole or in part, USEPA shall timely notify Johns-Manville in writing as to what it believes should be done to complete the Work, a statement of why such is needed to complete the Work, and a proposed schedule therefor.

3. A decision to approve the Work shall be based upon whether the Work has been completed in accordance with the

standards and specifications described in paragraph IV of this Consent Order and whether the Work is consistent with the National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300 (1983).

4. If Johns-Manville does not object to the corrective measures, if any, proposed by USEPA within thirty days after receiving written notice, Johns-Manville shall expeditiously undertake and complete such measures in accordance with the proposed schedule of completion.

5. If Johns-Manville objects to any proposed corrective measures, Johns-Manville shall, within thirty days after receiving written notice, notify USEPA of its objections and the reasons therefor.

6. Any issue not reconciled by agreement of the Signatories to this Consent Order within thirty days from the date upon which Johns-Manville notifies USEPA of any such objections, shall be deemed resolved in favor of USEPA and the changes made by USEPA shall become part of the Consent Order as specified in paragraph 1 above. USEPA agrees to attempt to reconcile any disagreements with Johns-Manville and to negotiate such attempts in good faith.

7. Johns-Manville waives any right it may have to contest or adjudicate the validity of any term in this Consent Order, except any terms adopted pursuant to paragraph 6 above

or otherwise expressly reserved herein. Johns-Manville may challenge any term adopted pursuant to paragraph 6 above in any action brought by USEPA to enforce the term or in any action brought by Johns-Manville to contest the term.

D. Documents, including progress reports and approvals, to be submitted to the Signatories shall be sent by certified mail return receipt requested, to the following addresses or to such other address as the Signatories hereafter may designate in writing:

1. Those documents to be submitted to USEPA should be sent in duplicate to:

Director, Waste Management Division
USEPA, Region V
230 South Dearborn Street
Chicago, Illinois 60604

2. Those documents to be sent to Johns-Manville should be sent to:

Stephen V. Moser, Esq.
Manville Service Corporation
Ken-Caryl Ranch
P.O. Box 5723
Denver, Colorado 80217

K. Nerheim
Manville Service Corporation
Ken-Caryl Ranch
P.O. Box 5108
Denver, Colorado 80217

E. If the date for submission of any item or notification required by this Consent Order falls upon a weekend or state or federal holiday, the time period for submission of

that item or notification is extended to the next working day following the weekend or holiday.

VI. DELAY IN PERFORMANCE; STIPULATED PENALTIES

A. Johns-Manville shall pay into the Hazardous Substances Response Trust Fund administered by USEPA the sums set forth below as stipulated penalties for each week that Johns-Manville fails to submit a report or document in accordance with the requirements contained in this Consent Order.

The provisions that are subject to stipulated penalties are as follows:

1. Paragraph IV(A)(2), submission of Water Balance Study Report;

2. Paragraph IV(A)(3)(c), submission of Remedial Investigation Report;

3. Paragraph IV(A)(3)(e), submission of Feasibility Study Report;

4. Paragraph V(B), submission of Written Progress Reports.

These stipulated penalties shall accrue in the amount of $1,000.00 for the first week and $2,000.00 for each week thereafter only for a period of one month unless USEPA has provided Johns-Manville with written notice of a failure to make such submissions.

B. Johns-Manville shall notify USEPA within twenty days of any delay caused by circumstances beyond the control of Johns-Manville which occurs in the performance of the Work or the submission of reports required under this Consent Order. Such notification shall be in writing and shall describe fully the nature of the delay, the reasons therefor, the expected duration of the delay, the actions which will be taken to mitigate further delay, and the timetable by which the actions in mitigation of the delay will be taken. Johns-Manville will adopt all reasonable measures to avoid or minimize any such delay.

C. Any failure by Johns-Manville to complete properly the Work or submit reports which result from circumstances beyond the control of Johns-Manville shall not be deemed to be a violation of its obligations under this Consent Order nor shall it make Johns-Manville liable for the stipulated penalties contained in paragraph VI(A) of this Consent Order. To the extent delay is caused by such circumstances beyond the control of Johns-Manville, the time for performance hereunder shall be extended.

D. In the event Johns-Manville and USEPA cannot agree that the time for performance shall be extended, the dispute shall be resolved in accordance with the provisions of paragraph V of this Consent Order except that Johns-Manville

shall have the burden of proving that the delay was caused by circumstances beyond the control of Johns-Manville.

E. The stipulated penalties set forth in subparagraph VI(A) above shall not preclude USEPA from electing to pursue any other remedies or sanctions, including a suit for statutory penalties up to the amount authorized by law, which may be available to USEPA by reason of Johns-Manville's failure to comply with any requirements of this Consent Order. However, in the event that Johns-Manville fails to submit the reports described in subparagraph VI(A) above, USEPA shall only be able to seek the stipulated penalties set forth in that subparagraph for those violations unless Johns-Manville repeatedly or in bad faith fails to submit the reports described in subparagraph VI(A) above. In that event, USEPA may seek other remedies or sanctions, including statutory penalties up to the amount authorized by law, for those violations.

VII. ACCESS TO THE DISPOSAL AREA

USEPA and its authorized representatives shall have access to the Disposal Area at all reasonable times in order to observe and monitor the progress of the Work, to take samples from and to inspect the Disposal Area, and to inspect records relating to the performance of the Consent Order as provided in Section 104(e)(1) of CERCLA.

VIII. PROJECT COORDINATORS

A. Johns-Manville and USEPA shall each designate a Project Coordinator for the purpose of overseeing the implementation of this Consent Order. To the maximum extent possible, except as specifically provided in this Consent Order, communications among Johns-Manville and USEPA concerning the terms and conditions of this Consent Order shall be made between the Coordinators.

B. Within fifteen (15) days of entry of this Consent Order, the Signatories shall notify each other, in writing, of the name, address and telephone number of the designated Project Coordinator and of any Alternate Project Coordinator.

C. Each Project Coordinator shall be responsible for assuring that all communications from the other are appropriately disseminated and processed.

D. The Project Coordinator for USEPA ("OSC") shall have the authority vested in an on-scene coordinator by 40 C.F.R. Part 300 (1983), including authority to require Johns-Manville to cease performance of the Work or any portion thereof which in the opinion of the OSC, may or does present or contribute to an endangerment to public health, welfare or the environment. In the event the OSC does require such cessation of the Work, the OSC then shall have the authority to require Johns-Manville to perform the Work

consistent with paragraph IV of this Consent Order in accordance with the instructions of the OSC to avoid or mitigate the endangerment, which he or she believes may occur. If Johns-Manville objects to any order requiring cessation of the Work or to any order to perform the work in accordance with the instructions of the OSC, Johns-Manville may petition a court with competent jurisdiction to stay or set aside the order of the OSC.

E. The Project Coordinator for Johns-Manville or any of the Alternate Project Coordinators for Johns-Manville, shall be on-site during all hours of work and shall be on call for the pendency of this Consent Order.

F. The Regional Administrator of Region V, USEPA or his designee shall have the authority to extend the time period for implementation or completion of an item of Work described in paragraph IV of this Consent Order for a period not to exceed fifteen additional working days without need for modification of this Consent Order for each event or occurrence for which Johns-Manville demonstrates that such extension is necessary. Extensions of time shall be documented in writing.

IX. SAMPLING AND ANALYSIS

USEPA and Johns-Manville shall make available to each other and to IEPA the results of sampling, tests, or other data generated by them, or on their behalf with respect to implementation of this Consent Order. At the request of either USEPA or Johns-Manville, the one shall provide the other with split or duplicate samples of any samples taken during the implementation of this Consent Order. If the OSC has notified Johns-Manville in writing that USEPA wishes to obtain split or duplicate samples or otherwise to observe and comment on any Work to be performed at the Disposal Area, Johns-Manville shall notify the OSC at least three working days in advance of the performance of the Work about which such notification has been received.

X. RETENTION AND AVAILABILITY OF INFORMATION

Johns-Manville shall retain during the pendency of this Consent Order and for a period of six years after its termination, all records and documents in its possession, custody, or control which relate to the performance of this Consent Order. Notwithstanding any other provisions of this Consent Order, USEPA and Johns-Manville retain whatever rights they may have under applicable statutes, laws, and regulations

governing the production of records and documents; in particular, USEPA retains the right to inspect records relating to the performance of the Consent Order as provided in Section 104(e)(1) of CERCLA.

XI. COMPLIANCE WITH ALL LAWS

All work undertaken by Johns-Manville pursuant to this Consent Order shall be performed in compliance with all applicable federal and state laws and regulations. Johns-Manville shall be responsible for obtaining all federal, state, or local permits which are necessary for the performance of the Work. USEPA shall expedite the processing of the permits required under its authority.

XII. PARTICIPATION IN COMMUNITY RELATIONS ACTIVITIES

Johns-Manville shall be given notice of and provided with the opportunity to participate in any public meetings which may be held or sponsored by USEPA to explain activities at or concerning the Disposal Area, including, without limitation, the findings of the RI/FS. To the extent practicable, USEPA shall consult with Johns-Manville in setting the dates and times of such public meetings.

XIII. REIMBURSEMENT OF RESPONSE COSTS

A. Within thirty days of the effective date of this Consent Order, Johns-Manville shall pay to USEPA the sum of $43,735.00 as reimbursement of response costs incurred by USEPA from August 26, 1982 through March 1, 1984. Payment shall be made to the order of the Hazardous Substances Response Trust Fund. Payment shall be forwarded to USEPA, Region V, Regional Hearing Clerk, 230 South Dearborn Street, Chicago, Illinois 60604. USEPA reserves its right to petition the United States Bankruptcy Court for payment of the response costs incurred by USEPA prior to August 26, 1982. Johns-Manville agrees to reimburse USEPA for the response costs incurred from August 26, 1982 through March 1, 1984 because of the specific facts and circumstances which relate to this Consent Order. Johns-Manville's agreement does not constitute nor is it to be construed as precedent for any agreement to pay response costs or for what constitutes response costs pursuant to CERCLA at any other site or location nor as precedent for what will constitute response costs for which Johns-Manville is liable pursuant to paragraph XIII(B) of this Consent Order and to Section 107(a) of CERCLA.

B. Within thirty days of the end of each calendar year, USEPA shall provide Johns-Manville with a full accounting

and explanation of the response costs incurred by USEPA in connection with the Disposal Area during the previous year. Within thirty days of receipt of this accounting and explanation, Johns-Manville will advise USEPA in writing as to whether or not it considers these costs to be necessary and consistent with the National Oil and Hazardous Substances Contingency Plan, 40 C.F.R. Part 300 (1983), and to be costs for which Johns-Manville is liable pursuant to Section 107(a) of CERCLA. Johns-Manville shall reimburse USEPA for all costs associated with USEPA's activities in connection with the Consent Order that are not inconsistent with the National Oil and Hazardous Substances Contingency Plan.

XIV. COVENANT NOT TO SUE

To avoid adjudication between the Signatories hereto and the expense that would be incurred in connection with such adjudication, and to set to rest the differences existing among them based on information known to the parties when settling this matter, USEPA has determined that full performance of the commitments made in this Consent Order constitutes full satisfaction of any and all civil claims which USEPA may have against Johns-Manville with respect to the performance of Remedial Investigations and Feasibility Studies pursuant to Section 104(a) and (b) of CERCLA and

40 C.F.R. Part 300, concerning the possible contamination at and from the Waukegan facility addressed in the scope of this Consent Order (hereinafter collectively referred to as the "Covered Matters") and USEPA hereby covenants not to sue, execute judgment, or take any civil, judicial or administrative action, under common law (federal or state), federal, state or local law, or any statutes administered or enforced by USEPA against Johns-Manville, its subsidiaries, divisions, parents, affiliates, or their respective directors, officers, employees, agents, successors and assigns arising out of or related to the Covered Matters. Except with respect to Covered Matters, this Consent Order does not release Johns-Manville from responsibility or liability for response actions at the Disposal Area or any other responsibilities or liabilities under Sections 104, 106, or 107 of CERCLA or any other provisions of CERCLA or any other Federal or State law; nor does this Consent Order release Manville from any responsibility or liability it may have to maintain the Waukegan facility in an environmentally safe manner during the pendancy of and following the termination and satisfaction of this Consent Order. USEPA is specifically without authority to waive any natural resources claims which the United States may have under Section 107(a)(4)(c) and (f) of CERCLA. It is not the purpose of this agreement nor the

intentions of the Signatories to release any other persons or entities not parties to this Consent Order from any claims or liabilities which they may have.

XV. TERMINATION AND SATISFACTION

The provisions of this Consent Order shall be deemed satisfied upon Johns-Manville's receipt of written notice from USEPA that Johns-Manville has demonstrated that all of the terms of the Consent Order have been completed. Following completion of the whole or any subpart of the Consent Order, Johns-Manville may request a determination by USEPA as to whether Johns-Manville has completed the whole or any subpart to the satisfaction of USEPA. USEPA shall provide Johns-Manville with such a determination within 30 days of the request by Johns-Manville.

XVI. CREATION OF ENDANGERMENT

In the event that the Regional Administrator of Region V, USEPA determines that activities implementing or in non-compliance with this Consent Order or any other circumstances or activities are creating an imminent and substantial endangerment to the health and welfare of the people on the Site or in the surrounding area or to the environment within the meaning of Section 106 of CERCLA, the Regional Administrator of Region V, USEPA may order Johns-Manville to stop

further implementation of this Consent Order for such period of time as needed, and may order Johns-Manville to take whatever actions are necessary to abate the endangerment or may petition a court of competent jurisdiction for such an order. During this time, Johns-Manville's obligations pursuant to this Consent Order shall be suspended and the time schedule for implementation shall be extended by the time period of the delay.

XVII. OTHER CLAIMS

Johns-Manville agrees to indemnify and save and hold harmless USEPA from any and all claims or causes of action arising from negligent acts or omissions or willful misconduct of Johns-Manville in carrying out the activities pursuant to this Consent Order, except for worker compensation claims by Federal employees. USEPA shall notify Johns-Manville of any such claims or action within twenty working days of receipt by USEPA of such a claim or action. USEPA agrees not to act with respect to any such claim or action without first providing Johns-Manville an opportunity to participate. USEPA further agrees to cooperate with Johns-Manville in the defense of any such claim or action.

USEPA shall not be held liable under or as a party to any contract entered into by Johns-Manville in carrying out the activities pursuant to this Consent Order.

XVIII. RESERVATION OF RIGHTS

A. Except as expressly provided in this Consent Order, Johns-Manville and USEPA expressly reserve all rights and defenses that they may have, including USEPA's right to disapprove the Work performed by Johns-Manville as provided in this Consent Order in which event USEPA will have the right to undertake its own remedial investigation, feasibility study, and remedial action and to seek reimbursement from Johns-Manville thereafter for such costs incurred by the Hazardous Substances Response Trust Fund.

B. Nothing herein shall be construed to release Johns-Manville from liability, if any, that it may have with respect to matters other than Covered Matters.

C. Johns-Manville, in entering into this Consent Order does not admit, accept, or intend to acknowledge any liability or fault with respect to any matter arising out of or relating to the Disposal Area or the Waukegan facility.

XIX. PUBLIC COMMENT, APPROVAL OF THE COURT AND THE EFFECTIVE DATE OF CONSENT ORDER

A. Within 30 days of the date of signature by Johns-Manville and USEPA of this Consent Order, Johns-Manville shall petition the United States Bankruptcy Court for approval to enter into this Order.

B. USEPA shall simultaneously announce the availability of this Consent Order to the public for review and comment. USEPA shall accept comments from the public for a period of thirty days after such announcement. If sufficient interest warrants, as determined by USEPA, a public meeting will be held. At the end of the comment period, USEPA shall review all such comments and shall either:

1. Determine that the Consent Order should be made effective in its present form, in which case Johns-Manville shall be so notified in writing; or

2. Determine that modification of the Consent Order is necessary, in which case Johns-Manville will be informed as to the nature of all required changes. If Johns-Manville agrees to the modifications, the Consent Order shall be so modified.

C. In the event that Johns-Manville is unwilling to agree on modifications required by USEPA as a result of public comment, this Consent Order may be withdrawn by USEPA. In such an event, USEPA reserves all rights to take such actions as it deems necessary, and Johns-Manville reserves all rights to contest such actions.

D. In the event that the Signatories agree on the final form of this Consent Order, the Consent Order shall become

effective upon signature of USEPA and Johns-Manville and approval of the United States Bankruptcy Court.

IT IS SO AGREED:

By: J. T. Hulet
Johns-Manville Sales Corporation

IT IS SO ORDERED:

By: Rebt. V. Adamkus
Regional Administrator, United States Environmental Protection Agency

Signed: June 14th, 1984

Entry of this Order is hereby approved:

By: _____ Signed: _____
United States Bankruptcy Court

EXHIBIT 1

I. PLAN FOR ADDITIONAL MONITORING

Specifications for a new air monitoring study are presented in this section. Included are discussions of air sampling, sample analysis, quality assurance procedures, and data interpretation.

A. Sampling Plan

The purpose of air monitoring is to estimate levels of airborne asbestos at the Johns-Manville site and to compare them with levels at sites which are not influenced by disposal site activities or other sources of asbestos. This requires estimation of both average concentrations and the variability of measured levels at each site. The sections which follow describe considerations for selecting (1) the background site, (2) the number of samples required for various levels of precision in the measurements, (3) the location of monitors at each site, and (4) the sampling times and volumes. The final section describes sampling instrumentation and procedures.

1. Background Site Selection

A desirable location for a background site is one far upwind from the waste disposal site. Given the expected predominance of winds from the east, west, northeast, and southwest (and thus the low probability of northerly winds)

due to lake/land effects at the Johns-Manville site,* a location to the south of the plant should be sought for a background site. To assure minimal influence from the waste site, a distance of at least 5 km is recommended. The site itself should be a relatively homogeneous area in terms of land use, and should not be influenced by any other source of asbestos.

Of particular importance is the location of tire stores or automobile shops where brakes are repaired. Since asbestos is frequently used in brake materials, brake repair operations may be a significant source of airborne asbestos.

Sites near gravel or dirt roads should also be avoided for two reasons. First, these sites may be very dusty and, thus, overloading of collection filters may become a problem. Second, some communities have used asbestos-containing crushed stone for road paving. Traffic on these roads may suspend asbestos fibers.

Any data on airborne asbestos from previous air monitoring studies in the Waukegan area should be used in selecting a background site. Low measurements near candidate sites would confirm their suitability.

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* Prevailing annual wind patterns at a local airport are NE-SW. A lake-side location should accentuate this pattern and further minimize northerly winds.

2. Number of Samples

The number of samples needed for a desired level of precision in the results depends on the magnitude of the variability associated with all phases of the sampling and analysis process. If several air samples are taken in the same general area but at slightly different locations (e.g., at different points within the waste disposal site) or at different times at the same location, the measurements of sampled material will differ from one another. These differences constitute the sampling component of variability. Sampling variability is due to random fluctuations in the population being sampled, and to factors such as wind speed and direction, atmospheric stability conditions, and the distance from emission sources such as dumping activities or roadways. These latter factors may be viewed as systematic influences on sampling variability, and potentially can be accounted for through sample design.

A second type of variability is that associated with the air sampling instrumentation and chemical analysis procedures. This is called analytic variability and is especially important for asbestos since asbestos fibers are difficult to detect and characterize. This variability can be further subdivided into variability between laboratories and variability within laboratories. Variability between labora-

tories is due to differences in types of equipment, interpretation of procedures, and analytical practices; variability within laboratories is due to differences between individual analysts (based on differences in experience and training) and differences between repeated readings obtained from the same sample by a single analyst as a result of variability in preparing a sample and in counting fibers.

Due to the sources of variability enumerated above, the measured concentration of asbestos in a single air sample collected at one location for a short period of time is unlikely to be equal to the concentration averaged over the entire site and for a longer time. The degree to which a single estimate departs from the area-wide, long-term value is called the estimation error. This error can be reduced by forming an average of samples taken at more locations, at more times, and by repeated measurement in the laboratory. The magnitude of error will depend both on the number of samples and the total sampling and analytic variability of the measurements.

In order to calculate the number of samples required to achieve a desired estimation error, the amount of expected variability in the measurements must be approximated or assumed. Some data are available from which estimates can be made of variability associated with the analytical method (between

and within laboratories), but the spatial and temporal variability of airborne asbestos at the Johns-Manville site is unknown. Therefore, required sample sizes have been calculated assuming a range of possible variabilities, where variability is measured relative to the expected concentration using a term called the coefficient of variation (standard deviation divided by the mean). A large coefficient of variation (e.g., greater than 100%) reflects a high level of variability.

Table 1 shows the relationship between the coefficient of variation, estimation error, and the number of required samples.* For example, if the coefficient of variation for the measurements is 100%, then taking 19 samples will "assure" that the estimation error is $\pm$ 60% of the "true" mean.+ In other words, the average concentration for 19 samples should fall somewhere between 60% less than and 60% greater than the "true" mean. Increasing the sample size to 25 reduces the estimation error to $\pm$ 50% of the true mean. Once the

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* These calculations are based on several assumptions which may hold only approximately in practice. Therefore the sample sizes should be used only as a guide. See Appendix A for a discussion of the assumptions underlying the calculations.

+ Although it is not possible to be absolutely sure that the "true" mean will fall within this interval, the probability is high. See Appendix A and footnotes to Table 1. "True" mean simply refers to the area-wide, long-term average.

Table 1. The Relationship Between Sample Size, Coefficient of Total Variation, and Estimation Error

Coefficient of total variation[a]	Maximum acceptable estimation error as a percentage of the true mean[b]	Required sample size[c]
100%	25%	78
	50%	25
	60%	19
	75%	14
	80%	13
	100%	10
150%	25%	160
	50%	48
	60%	35
	75%	25
	80%	22
	100%	16

[a] Standard deviation divided by the mean and expressed as a percentage.

[b] Based on the 95% confidence interval for the true mean calculated from the observed data.

[c] The number of samples required to ensure that the estimation error is less than the specified amount in the second column, with a probability of 90%.

samples have been collected and a sample average calculated, this average becomes the best estimate of the true mean and an actual estimation error is calculated from the sample variance. (This procedure is discussed in Appendix A.)

The two coefficients of variation in Table 1 (100% and 150%) have been selected based on limited data on (1) laboratory variability in measuring asbestos, and (2) temporal variability in particulate matter concentrations at a few sites.* Extrapolating from these data, the coefficient of total variability for airborne asbestos will likely be at least 100% and may be higher than 150%.

A minimum of 25 samples is recommended for the Johns-Manville site. This sample size would provide an estimation error of $\pm$ 50% of the true mean if the coefficient of variation is 100%, or $\pm$ 75% if the coefficient of variation is 150%.

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* Very limited evidence suggests that the coefficient of variation in asbestos measurements due to variability between laboratories may be 50-90% (Steel et al. 1982) and within laboratories, 30-40% (USEPA 1983). Temporal variability in 24-hour measurements of particulate matter at a sample of sites in Illinois (1980 data) produced a coefficient of variation which averaged about 45% (data from USEPA 1981).

For measurements of asbestos levels at background sites, a larger estimation error might be tolerable. For example, it may be sufficient to know only that the background concentration is less than some relatively low level, perhaps 30 ng/m^3. If the actual mean is 10 ng/m^3, then the maximum tolerable estimation error is $^{-100\%}_{+200\%}$ (or a one-sided error of +200%). A sample size of 5 would be sufficient to "assure" that the estimation error was no larger than this limit. Five samples are thus recommended for the background site.

To illustrate how the size of the estimation error influences interpretation of the monitoring results, suppose the measured mean concentration at the waste site were 200 ng/m^3 with an estimation error of $\pm$ 75%, and the mean at this background site were 10 ng/m^3 with an error of + 200%. Thus, we could say (with 95% confidence) that the waste site concentration is between 50 and 350 ng/m^3 and the background concentration is between 0 and 30 ng/m^3. In this example, we can be confident that the two concentrations are clearly different. The smaller the estimation errors, the easier it is to distinguish measured concentrations at the two sites.

3. Monitor Location

Since the air samples collected should be representative of typical concentrations at each site, they must capture both spatial and temporal variations in air levels.

For the waste disposal site, five sampling locations and five sampling times are recommended, thus making a total of 25 separate samples. The sampling locations should be randomly selected within the following constraints: all locations should be at least 30-m from the boundaries of the site (to assure that measurements reflect on-site emissions), and the set of five locations should be approximately symetrical so as to capture high concentration irrespective of wind direction or distance from on-site "sources" (e.g., the disposal pit, roadways, the main landfill). One way to select the sampling locations is to construct a transparent template with a grid superimposed on a circle with five radial sectors (i.e., each sector subscribes 72^{o}). The template is made about as large as a scale map of the waste site and placed on top of the map. The grid points on the template are numbered and a random number table used to select one location within each sector. Of course, if a selected location falls on water or another physically unsuitable spot, a substitute must be chosen within that sector. This design is intended to make the spatial variability in asbestos concentration random.

For the background site, a single monitor operated for the same five time periods is desirable. A single monitor will suffice since temporal variability is likely to be greater

than spatial variability there. The specific location of the monitor will be governed by the usual considerations of security, access, and power availability. Locations near sources of dust should be avoided to prevent overloading of filters with particulate matter.

4. Sampling Times and Volumes

Based on the likelihood of day-to-day variability in on-site activity and meteorological conditions, sampling should be conducted on five separate days. Sampling periods of 12 hours for the waste site and background monitors are suggested. The start and end hours for the 12-hour sampling period should be timed to coincide with the start and end hours of the day work shift at the Johns-Manville plant. These sampling periods should smooth out hourly variability in asbestos levels. Where possible, days with different wind speed and direction should be chosen. In all cases, days with rain or days following precipitation by less than 24 hours should be avoided.

The total volume of air to be sampled is dictated by (1) the lower detection limit of the analytical methodology,* (2) total concentrations of particulate matter at the sites

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* At least 10 asbestos fibers should be counted during EM examination (USEPA 1978).

(and, thus, the potential for overloading filters), and (3) accepted operating practices for sampler flow rates and filter face velocities for airborne asbestos monitoring (Yamate 1982). Based on the findings of the EEI study and on other airborne asbestos monitoring studies (USEPA 1983), a total sample volume of 6,000-11,000 liters is recommended. A volume of 10,800 liters would be collected if the samplers were operated at a flow rate of 15 lpm (12 hrs. at 15 lpm).

Filter "overloading" usually refers to gross clogging of the filter media. In the context of monitoring airborne asbestos, however, it may refer to contamination of the filter with substances other than asbestos fibers. This would require that the filtered material be ashed and refiltered prior to examination by EM. Since ashing and refiltering is not the preferred treatment, a pretest of the sampling plan is recommended to test for contamination.

Ashing and refiltering is also necessary if Millipore rather than Nuclepore filters are used. Millipore filters are sometimes used because they tend to retain fibers better during filter handling and transport. Thus, if the pretest reveals that contamination is a problem and that filter ashing will be necessary, the use of Millipore filters is recommended.

The pretest should consist of three monitors at a single waste site location. (The location should be one likely to produce high asbestos concentrations). The three monitors should be operated with three different flow rates: 5, 10, 15 lpm and the sampling time should be 12 hours. These combinations of flow rates and sampling times will produce high enough sample volumes to assure sufficient quantities of fibers for precise estimates at the highest rate (15 lpm) and low enough filter loadings to reduce contamination by nonasbestos material at the lowest (5 lpm).

After collection, the three pretest samples should be examined by the EM laboratory. Sample preparation should not include ashing and refiltering. If contamination by nonasbestos materials is still substantial at the lowest flow rate in the opinion of the electron microscopists, then the use of Millipore filters and ashing/refiltering procedures will be necessary. Otherwise, the highest of the flow rates which still produces satisfaction fiber identification and measurement should be selected for the monitoring study.

5. Instrumentation and Sampling Specifications

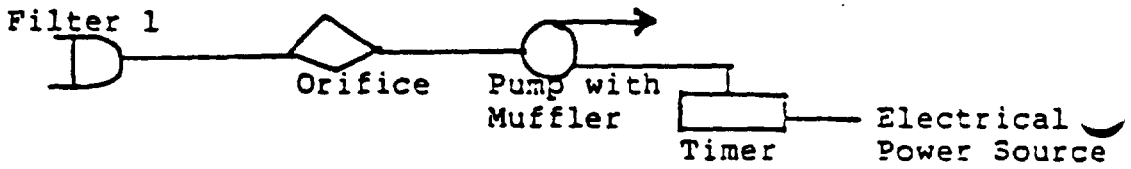
The following sampling procedures are within the class of procedures tested and recommended by EPA (USEPA 1978 and Yamate 1981). More specific information on selected procedures can be found in Appendix B.

a. Sample Setup

The sampling system should consist of:

- A Gelman magnetic-type open-face filter;
- A critical flow orifice;
- A diaphram pump with muffler;
- Associated plumbing and stand; and
- Timer (if desired).

The sampler setup is schematically represented as follows.



b. Specifications

- Flow rate: 5, 10, and 15 lpm for the pretest; one of the three will be selected for the study;

- Filter type: For the pretest and if non-asbestos contamination or fiber loss from the filter is not a problem: 47 mm polycarbonate Nuclepore with a 0.4μm pore size. At least two 47 mm cellulose acetate (Millipore type HA) filters with 5μm pore size should be used to support the Nuclepore filter.
If contamination by nonasbestos particulate matter is a problem: 47 mm cellulose acetate (Millipore type HA) with 0.45μm pore size.

- Filter height: 1.5 m

c. Sampling Protocol

1. Clean and dry filter holder.

2. Place filter in holder, assuring proper position, see filter handling section below.

3. Mount filter holder such that filter is in a vertical position (perpendicular to ground).

4. Start pump and position filter on holder before replacing holder top to prevent wrinkles.

5. Check plumbing for leaks and check filter holder to assure that it is free of vibration.

6. Check flow with flowmeter using manual control of pump.

7. Set automatic timer to desired on-off time settings (if timer is to be used).

8. Make appropriate logbook entries.

9. Conduct sampling.

10. After sampling period, check flow.

11. Rotate filter to a horizontal position and remove. Secure Nuclepore or Millipore filter in a petri dish with tape for proper handling and transport.

d. Filter Handling

During loading and unloading of the filter holder, the filters should be handled by forceps (not with fingers). When a filter is removed after exposure, it should be placed in the petri holder exposed side up and maintained in that position during the handling and transport of samples back to the laboratory. The samples should be hand-carried to the selected TEM laboratory in a container that will keep the petri dish in a horizontal (flat) position at all times (handling, transport, and storage).

The chain-of-custody system should be followed at all times (see Appendix B). A chain-of-custody record, therefore, will be kept on each filter.

Field blanks should be randomly selected at each site and for each sampling time (see Section I. C. below). Any dropping or mishandling of a filter after collection must be recorded. Each filter holder should be labeled according to a coding system. Laboratory blanks should be selected prior to field sampling (see Section I. C.). If possible, all filters at the same site should be from the same production lot.

e. Meteorological Observations

A wind vane and anemometer should be used to record wind direction and speed at the waste site. Recorded data should then be used to draw a wind rose for each day of sampling.

f. Logbook

An important part of any successful field program is the accurate observations and recordkeeping of the field team. At a minimum, logbook entries should include:

1. Name of field operator;
2. Date of record;
3. Number and location of site;
4. Position of sampler within site;
5. Brief description of site;
6. Corresponding filter number;
7. Sample flow rate at start of sampling period;
8. Start time;

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Table 2. Summary of Key Elements of New Air Monitoring Study

Site	Number of monitors	Sampling Time	Flow Rates		Type of Filter		EM Sample Preparation	
			Pretest	Study	Pretest	Study	Pretest	Study
Waste	5	5 days at 12 hrs/day	5, 10, & 15 lpm[a]	5, 10, or 15 lpm	Nuclepore	Nuclepore or Millipore[b]	Carbon coating only	Carbon coating only or preceded by ashing & refiltering[c]
Background	1	5 days at 12 hrs/day	--	5, 10, or 15 lpm[a]	--	Nuclepore or Millipore[b]	--	Carbon coating only or preceded by ashing & refiltering[c]

[a] Depends on results of the pre-test, 15 lpm recommended unless a lower rate eliminates contamination by organic materials.

[b] Use Nuclepore filters if nonasbestos contamination is not a problem (based on results of pre-test); otherwise, use Millipore filters.

[c] Use ashing and refiltering procedures if Millipore filters are used.

9. Stop time;
10. Sample flow rate at end of sampling period;
11. Wind rose for the sampling period;
12. Description of meteorological conditions; and
13. Comments.

B. Sample Analysis

Air samples should be analyzed by transmission electron microscopy according to the methodology recommended by EPA (USEPA 1978 and Yamate 1981). Two alternative sample preparation protocols are employed. The first is utilized when the sample is collected on polycarbonate Nuclepore filters and, thus, when contamination by nonasbestos materials is not a problem. The second protocol is employed when the sample is collected on Millipore filters (typically cellulose ester or acetate). Which protocol is employed will be determined by the outcome of the pretest, as discussed previously. Brief descriptions of the two protocols are provided below; detailed sample analysis instructions appear in Appendix B.

1. Sample Preparation

a. Samples on Nuclepore Filter

When Nuclepore filters are used, the filter is coated after sampling with a carbon film using a vacuum process. The coated sample is then transferred to an EM grid using a modified Jaffe washer technique. In essence, the Nuclepore filter is placed on top of a carbon-coated EM grid

and the filter is dissolved with chloroform. This deposits the carbon-coated sample directly on the grid.

b. Samples on Millipore Filters

Samples on Millipore filters must be ashed and then refiltered on a Nuclepore filter. The filters are first ashed at low temperatures to destroy the filter medium and combustible contaminants. The ashed residue is then re-dispersed by ultra-sonification and filtered with a Nuclepore filter.

2. EM Examination

Fibers are scanned, counted, and sized using an electron microscope at 20,000X magnification. Asbestos fibers are identified using selective area electron diffraction (SAED) analysis.

C. Quality Assurance

To ensure that the information obtained from the air monitoring study is reliable, a quality assurance (QA) program is needed. A formal QA plan has been developed according to the USEPA Office of Toxic Substances (OTS) requirements. This plan establishes organizational responsibilities and specifies procedures for implementing the plan. A complete QA plan is described in Appendix B; only the names of the team members need to be added. The key elements of the QA objectives are briefly described below.

As per OTS specifications, the plan covers, in more detail, the information on sampling and analysis procedures described previously. However, its primary objective is to assure the quality of the data produced.

1. Documentation

Once completed, the QA program provides documentation of all procedures and activities. Such documentation raises the confidence of everyone associated with the study, especially potential users of the study results. Documentation also allows the handling and treatment of individual samples to be traced, if this is needed.

2. Corrective Action

A QA program will provide a mechanism for taking corrective action in response to the identification of data problems. Ideally, corrective action will be taken quickly enough to hold the loss of data to a small fraction of the entire data set.

3. QA Checks

A QA program establishes a series of checks to detect gross problems with data collection, handling, and analysis procedures. These include the analysis of blank samples, multiple analyses of single samples within a laboratory, and multiple analyses by more than one laboratory.

a. Field and Laboratory Blanks

During each sampling period and at each sampling site (i.e., waste disposal and background sites), at least one filter should be randomly selected as a field blank from the filter supply. Thus, a total of 10 field blanks is needed for this study. The blank filter is labelled and handled as any other filter but is not actually used for air sampling. A proportion of the field blanks (at least three) are submitted for analysis along with the test filters. The field blank provides a check for possible filter contamination. If contamination appears to be a possibility, additional field blanks can be analyzed to help determine the extent of the problem.

In a similar manner, at least three blank filters should be exposed on a laboratory bench during preparation and analysis of the samples. At least one of these is then analyzed to check for contamination in the laboratory.

b. Replicate and Duplicate Filter Analysis

As a means of quantifying analytical variability due to preparation and counting procedures, some filters should be selected at random for replicate analysis and some for duplicate analysis. Replicate analyses are done using two independent preparations from the same filter. Duplicate analyses are done by two different analysts using the same TEM grid preparation. It is recommended that a minimum of

three filters be selected for each type of analysis and that further analyses be conducted if serious discrepancies appear. For this reason, it is important that all filters and sample preparations are carefully stored.

c. Interlaboratory Quality Assurance

A proportion of the filters (usually about 10% or three for this study) should be analyzed by a second laboratory. These filters are selected at random from the test filters and each is divided in half. One half is analyzed by the main laboratory and the other half by the second laboratory. If serious discrepencies appear, additional filters should be analyzed.

D. Statistical Evaluation

The data will be used to estimate a mean airborne asbestos concentration for the Johns-Manville waste disposal site and for the background site.* For each mean, a 95% confidence interval will be obtained to provide a measure of the estimation error. Comparisons between disposal site and background air levels can be made using standard statistical methods.

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* Averages could also be estimated for subareas within the waste site, but the confidence intervals for these estimates would be very large due to the small number of samples. Data on wind direction and speed will be used to judge the representativeness of the asbestos measurements for each site.

After the data have been colected and an estimate of variance is available, it is possible to evaluate the power of the statistical tests. In the case in which no statistically significant difference is found between two estimated means, the power calculation will provide a measure of how much confidence one can have in that conclusion.

The results from the various QA samples (field blanks, external labosatory, replicate, and duplicate samples) will be compared with the appropriate original analyses. The small number of QA samples precludes formal statistical analysis. However, if inconsistencies or large discrepancies are observed, further QA samples can be analyzed since only a portion of each filter is needed for each analysis.

E. Summary of Sampling and Analysis Design

Table 2 summarizes the key elements of the recommended air monitoring program.

Appendix A. Calculating Sample Sizes

The term "estimation error", as used in Section I. A.2, refers to half of the length of the 95% confidence interval for the true mean. This confidence interval will be calculated from the data after they have been collected and will indicate the magnitude of the error associated with the estimation of the true mean. If the coefficient of total variation is small and/or the sample size is large, then the confidence interval will be short and one will be confident that the true mean is not very different from the value estimated from the data. By "confident" it is meant that 95% of the time the procedure for calculating a 95% confidence interval results in an interval which actually includes the true mean.

The formula for the 95% confidence interval is:

$$\bar{x} \pm t_{(0.025,n-1)} \sqrt{s^2/n}$$

where $\bar{x}$ and s^2 are the calcualted sample mean and sample variance, respectively, and $t_{(0.025,n-1)}$ is the upper 2.5 percent point of the t distribution with n-1 degrees of freedom. Note that $t_{(0.025,n-1)} \sqrt{s^2/n}$ is the estimation error. The aim is to choose the sample size n so that $t_{(0.025,n-1)} \sqrt{s^2/n}$ is not too large. Suppose it is decided that this quantity should be no larger than $d\mu$ where μ is the true mean and d is a fixed proportion. For example, if the estimation error is required to be no more than 60% of the mean, then d would be made equal to 0.6. Then n has to be chosen so that $t_{(0.025,n-1)} \sqrt{s^2/n}$ is less than $d\mu$.

It is not possible to be absolutely sure that for a given sample size the resulting confidence interval is sufficiently small, but it is possible to attach a probability to the chance that it will be. For example, it is possible to find n such that the probability that the confidence interval is sufficiently small is 0.9 or 0.95, or any other desired level. If the desired level is $1-\beta$ then it is necessary to find n such that

$$P\left(t_{(0.025,n-1)}\sqrt{s^2/n} \leq d\mu\right) = 1-\beta.$$

This is equivalent to

$$P\left(\frac{(n-1)s^2}{\sigma^2} \leq \frac{(n-1)nd^2\mu^2}{\sigma^2(t_{0.025,n-1})^2}\right) = 1-\beta$$

If it is assumed that the n samples are independent observations from a normal distribution with mean μ and variance σ^2 then $(n-1)s^2/c^2$ has a X^2 distribution with (n-1) degrees of freedom. The problem is thus reduced to finding n such that

$$\frac{(n-1)nd^2\mu^2}{\sigma^2\,(t_{(0.025,n-1)})^2} = X_{n-1} \ ,$$

where X_{n-1} is the upper (100%) β percentage point of the X^2_{n-1} distribution. Substituting $\sigma^2 = c^2\mu^2$ gives

$$n = \left(1 + \sqrt{1 + 4\,(t_{(0.025,n-1)})^2\,(c/d)^2\,X_{n-1}}\right) /2$$

which can be solved by trial and error.

Table A-1 shows the values of n for different values of the cofficient of variation (c), the size of the 95% confidence interval (estimation error) and different values of the probability of obtaining an error as small or smaller. For example, if the coefficient of variation is 100% and one wants to ensure with probability 0.95 that the estimation error is no greater than ±50% of the true mean, then 27 samples are required. If only 22 samples are collected then the probability is reduced to 0.8.

Table A-1. Sample Size Required to Estimate the Mean with a Desired Level of Precision with the Coefficient of Variation Set at 100% and 150%

Maximum acceptable estimation error (%)[b]	Probability of achieving acceptable estimation error		
	0.8	0.9	0.95
Coefficient of variation = 100%[a]			
25	73	78	81
50	22	25	27
60	17	19	20
75	13	14	15
80	12	13	14
100	9	10	11
Coefficient of variation = 150%[a]			
25	154	160	176
50	44	48	50
60	32	35	38
75	22	25	27
80	21	22	24
100	15	16	17

[a]Standard deviation divided by the mean and expressed as percentage

[b]The length of the 95% confidence interval for the true mean calculated from the observed data.

Appendix B. A Sample Quality Assurance Plan

The organization of this QA Plan conforms to USEPA OTS specifications. The plan includes asbestos sampling and analysis protocols and procedures to assume the quality of the data produced.

SECTION 1.0

QUALITY ASSURANCE PLAN

for

MONITORING AIRBORNE ASBESTOS CONCENTRATIONS
AT THE JOHNS-MANVILLE CORPORATION ASBESTOS WASTE SITE,
WAUKEGAN, IL.

Approved for:		Approved for:	
_____		_____	
_____	_____	_____	_____
Department Mgr	Date		Date
_____	_____	_____	_____
QA Administrator	Date		Date

2.0 TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF FIGURES

3.0 PROJECT DESCRIPTION

The Johns-Manville Corporation operates an asbestos waste disposal site in Waukegan, Illinois. The EPA Region V Office is conducting an investigation of the site to assess the degree of hazard from airborne asbestos and the need for remedial action. As part of the EPA investigation, measurements of airborne asbestos concentrations at the site will be used to estimate the extent to which concentrations are elevated compared to background levels, and the exposure potential for residents of surrounding areas.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

4.1 Organization

The project organization is given in Figure 1.

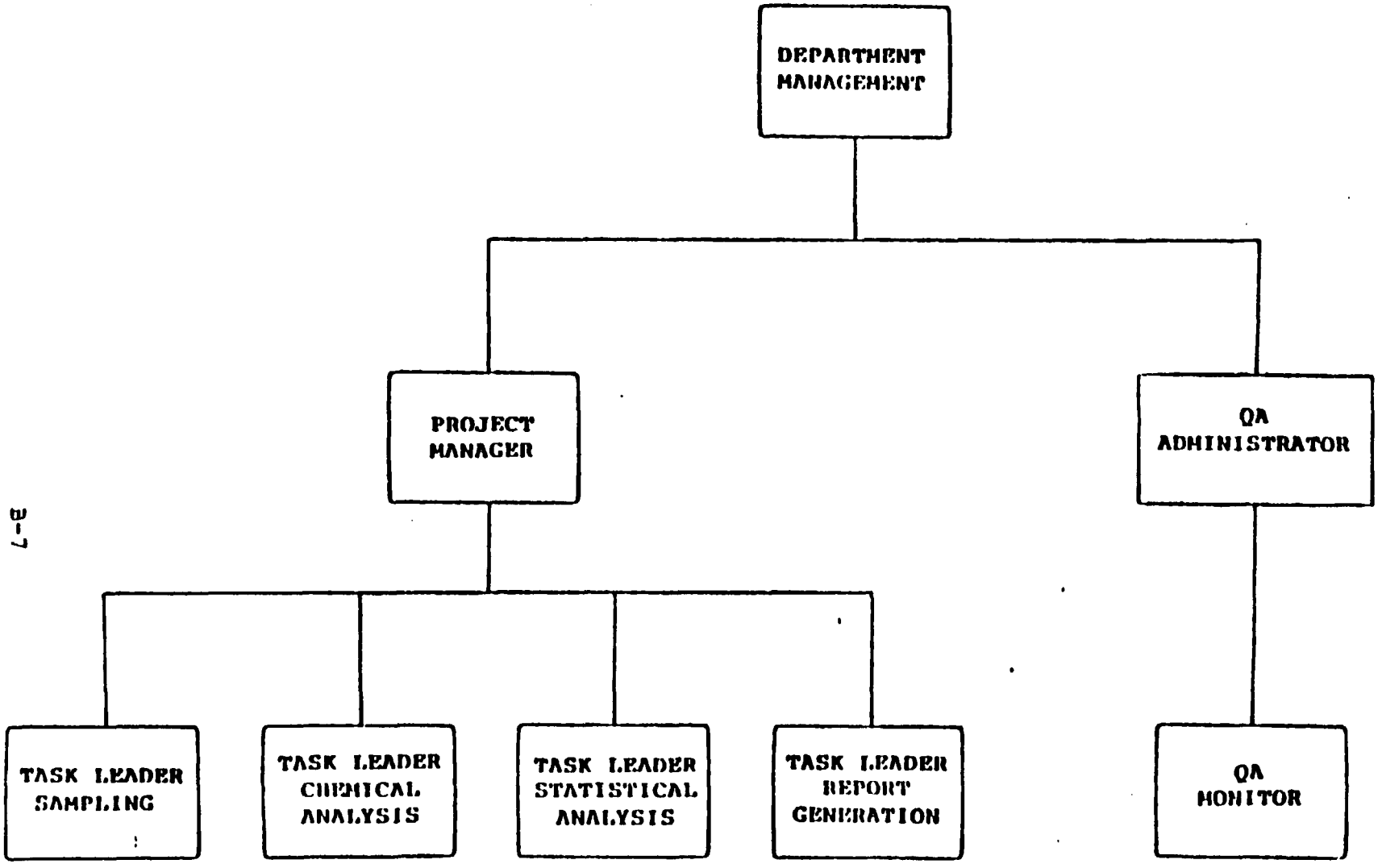
4.2 Responsibilities

4.2.1 Department Management

The individual representing Department Management shall be responsible for overseeing the project and will appoint a Project Manager and QA Administrator.

4.2.2 QA Administration

The QA administrator (QAA) shall review the QA plan, ensure that QA requirements are satisfied, and provide documentation to that effect to Department Management.



(3URE 1. PROJECT ORGANIZATI(

4.2.3 Project Manager

The Project Manager shall be responsible for coordinating sampling, chemical and statistical analyses, and report generation. Task Leaders may be appointed for these various tasks. The Project Manager shall assure that all personnel are fully informed of project QA policy and that any problems, deviations etc. are documented and corrective action is taken.

4.2.4 QA Monitor

The QA Monitor (QAM) shall:

- Plan the performance and systems audits.
- Closely monitor the results of the performance and systems audits.
- Communicate closely with the Project Manager.
- Periodically monitor and examine data books, forms, records, or any other hardcopy information.
- Determine and affirm data and sample traceability.
- Inform the Project Manager of any problems and request immediate corrective action.
- Screen data for transcription, calculation, or other errors.
- Provide monthly reports to the QAA.
- Provide documentation to the QAA affirming that the QA requirements of the project have been met.

5.0 QUALITY ASSURANCE OBJECTIVES

5.1 Accuracy

USEPA believes that transmission electron microscopy is the best available technique for measuring asbestos concentration at the Disposal Area because it provides a means of distinguishing asbestos fibers from nonasbestos fibers and also allows measurement of small as well as large individual fibers. Bundles or clusters of fibers are not included in the calculation of fiber or mass concentration because of the difficulty of assigning meaningful dimensions to these aggregates. Therefore, if bundles or clusters are present transmission electron microscopy (TEM), like any other optical technique, will tend to underestimate the mass concentration.

Subject to availability, National Bureau of Standards (NBS) standard filter preparations of known asbestos concentration will be used to assess the accuracy of the method. Since NBS standards have not been available previously there is little quantitative information on TEM accuracy.

5.2 Precision

Fiber counts by TEM can be expected to range from 1 to 1000. Thus, from 1 to 3 significant figures may be reported.

In the duplicate and replicate analyses, coefficients of variation (standard deviation divided by the mean) of the asbestos concentration are expected to be about 0.4 or below unless the concentrations are very low (50 ng/m^3)[1].

[1]Constant, P.C. et al, 1983. Midwest Research Institute Airborne Asbestos Levels in Schools. Final Report. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency. Contracts 68-01-5915 and 68-01-5848.

Sample sizes (see Section 6.0) have been selected to ensure that waste disposal site and background levels of asbestos fiber concentration will be estimated with reasonable precision. If the coefficient of total variation (standard deviation divided by the mean) is between 100 and 150% the estimated concentrations are expected[1] to have estimation errors[2] which are no greater than the true means ± 60%.[3]

5.3 Representativeness

The sampling plan specifies selection of background site and waste site monitoring locations to ensure representative measurements will be obtained. The background site should not be influenced by the waste site or other sources of asbestos. Air samples shall be taken at five sampling locations and at five sampling times within the waste site to capture both spatial and temporal variations in air levels.

5.4 Completeness

The most serious, and most difficult to control, cause of lost samples is human interference and vandalism. Sampling locations shall be chosen to minimize this risk. Loss of samples due to errors by the field sampling crew should not exceed 5 to 10 percent.

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[1] With probability greater than 90%.
[2] The estimation error is defined here as the size of the 95% confidence interval which will be calculated from the observed data.
[3] See Section V.A.2, "Number of Samples," and Appendix A of this report.

6.0 EXPERIMENTAL DESIGN

A single location at a background site and five locations at the waste disposal site will be selected. Air samples will be collected simultaneously at all six locations on five separate occasions. This will provide five background samples and 25 waste disposal site samples. This sampling plan is designed to encompass the expected spatial and temporal variability in asbestos concentration.

The sampling locations shall be chosen randomly within the constraints imposed by natural barriers and physical structures and so that any high concentrations of asbestos are likely to be sampled irrespective of wind direction or distance from an on-site 'source' (e.g., the disposal pit, roadways, the main landfill).

To determine the best type of filter, analytical treatment and pump flow rate, a pretest shall be carried out. The pretest will consist of three monitors at a single waste site location that is likely to produce high asbestos concentrations. Polycarbonate Nuclepore filters (0.4μm pore size) and three flow rates of 5, 10 and 15 lpm will be used for a 12-hour sampling period. The three pretest samples will be examined by an Electron Microscopy (EM) Laboratory with-without ashing or refiltering. If contamination by nonasbestos materials is still substantial at the lowest flow rate in the opinion of the electron microscopists, then the use of cellulose acetate Millipore (0.45μm pore size) filters and ashing/refiltering

procedures will be necessary. Otherwise, the highest of the flow rates which still produces acceptable fiber identification and measurement should be selected for the monitoring study.

A summary of the experimental design is given in Table 1.

TABLE 1. EXPERIMENTAL DESIGN FOR AIR MONITORING STUDY

Site	Number of monitors	Sampling time	Flow Rates		Type of Filter		EM Sample Preparation	
			Pre-test	Study	Pre-test	Study	Pre-Test	Study
Waste	5	5 days @ 12 hrs/ day	5, 10, & 15 lpm[a]	5, 10, or 15 lpm	Nuclepore	Nuclepore or Millipore[b]	Carbon coating only	Carbon coating only or preceded by ashing & refiltering[c]
Background	1	5 days @ 12 hrs/ day	--	5, 10, or 15 lpm[a]	--	Nuclepore or Millipore[b]	--	Carbon coating only or preceded by ashing & refiltering[c]

[a] Depends on results of the pre-test, 15lpm recommended unless a lower rate elimates contaimination by organic materials.

[b] Use Nuclepore filters if nonasbestos contamination is not a problem (based on results of pre-test); otherwise, use Millipore filters.

[c] Use ashing and refiltering procedures if Millipore filters are used.

7.0 PERSONNEL QUALIFICATIONS

The personnel involved in this study should be experienced in field sampling, chemical and statistical analysis, and the associated QA requirements. The individuals should be identified and their qualifications described as part of the QA plan.

8.0 FACILITIES AND EQUIPMENT

The source of equipment for the field sampling should be specified in the QA plan. An EM laboratory with the appropriate microscope factilities shall be selected for analysis of air samples.

9.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

The air sampling pump, which is the major sampling equipment item, is a diaphragm type pump which is essentially maintenance-free. Maintenance consists of a check prior to departure. If necessary, diaphragms are changed.

Maintenance records shall be maintained in appropriate notebooks.

10.0 CONSUMABLES AND SUPPLIES

The only major consumable items are the filters for the air pumps. If possible, all filters will be selected from the same lot; the numbers of the box and lot from which each filter is taken shall be recorded in the sampling logbook. Laboratory filter blanks will be used to check for contamination of the filter as described in Section 16.0.

11.0 DOCUMENTATION

All documentation in logbooks and other documents shall be in ink. If an error is made, it shall be corrected by crossing a line through the error and entering the correct information. Changes shall be dated, initialed, and the reason for the correction stated. The original entry must remain legible.

Details of field sampling, summaries of performance and system audits, sample transfer, results of QA analyses, etc., will be documented in appropriate laboratory notebooks and reports to management as described in the succeeding sections.

12.0 DOCUMENT CONTROL

Documents, such as this QA plan, shall be identified by

- Section number
- Revision number
- Date
- Page number

in the top right-hand corner of each page.

The Project Manager shall be responsible for ensuring that data books, notes, records, etc., pertaining to field sampling, results of chemical analyses and computer files used for statistical analyses are properly documented and stored.

The QA monitor, shall keep copies of traceability documents, random number codes applied to samples, summaries of the results of system and performance audits and other materials documenting the implementation of the QA plan.

All documents shall be retained for five years. After five years a decision will be made concerning which, if any, documents shall be retained for a longer period.

13.0 CONFIGURATION CONTROL

Air pumps will be placed according to the protocol given in Section 14.1, and regularly checked by the field sampling leader.

14.0 . SAMPLE COLLECTION

Airborne asbestos sampling will be conducted according to the general procedure outlined elsewhere[1]. This will involve samples taken at both background and waste disposal sites as specified in the sampling plan.

14.1 Selection of Sampling Location

Since the air samples collected should be representative of typical concentrations at each site, they must capture both spatial and temporal variations in air levels. For the waste disposal site, five sampling locations and five sampling times shall be collected, thus making a total of 25 separate samples. The sampling locations shall be randomly selected within the following constraints: all locations should be at least 30m from the boundaries of the site (to assure that measurements reflect emissions from "sources" at the site), and the set of five locations should be approximately symetrical so as to capture high concentration irrespective of wind direction or distance from individual "sources" (e.g., the disposal pit, roadways, the main landfill).

For the background site, a single monitor operated for the same five time periods is desirable. A single monitor will suffice since temporal variability is likely to be greater than

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1 "Airborne Asbestos Levels in Schools: A Design Study," by B. Price, C. Melton, E. Schmidt, and C. Townley, dated November 20, 1980, a special project report prepared by Battelle's Columbus Laboratories under EPA Contract No. 68-01-3858.

spatial variability there. The specific location of the monitor will be governed by the usual considerations of security, access, and power availability. Locations near sources of dust should be avoided to prevent overloading of filters with particulate matter.

14.2 Sampling Times and Volumes

Based on the likelihood of day-to-day variability in on-site activity and meteorological conditions, sampling should be conducted on five separate days. Sampling periods of 12 hours for the waste site monitors and background monitors shall be used. The start and end hours for the 12-hour sampling period should be timed to coincide with the start and end hours of the day work shift at the Johns-Manville plant. These sampling periods should smooth out hourly variability in asbestos levels. Where possible, days with different wind speed and direction should be chosen. In all cases, days with rain or days following precipitation by less than 24 hours should be avoided.

The total volume of air to be sampled is dictated by (1) the lower detection limit of the analytical methodology,[1] (2) total concentrations of particulate matter at the sites (and, thus, the potential for overloading filters), and (3) accepted operating practices for sampler flow rates and filter face velocities for

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[1] At least 10 asbestos fibers should be counted during EM examination. (USEPA 1978. U.S. Environmental Protection Agency. Electron Microscope Measurement of Airborne Asbestos Concentrations, A Provisional Methodology Manual. Research Triangle Park, NC: Office of Research and Development, U.S. Environmental Protection Agency. EPA 600/2-77-178.)

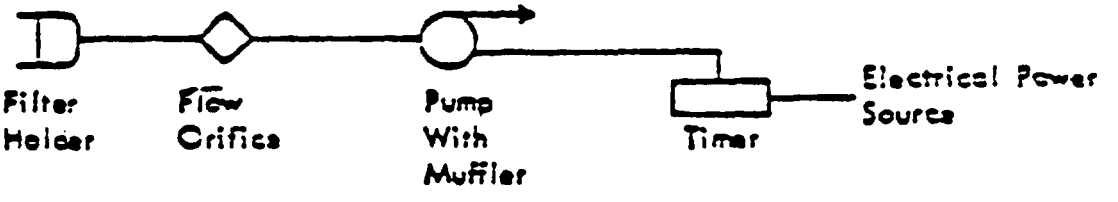
airborne asbestos monitoring[1]. The flow rates shall be selected based on the results of the pretest as described in Section 6.0.

14.3 Sampler Setup

The sampling system consists of:

1. An open-face filter holder.
2. A control flow orifice.
3. A pump with muffler.
4. Associated plumbing and stand.
5. A method of measuring sampling time.

The sampler setup is schematically represented as follows.



14.4 Sampling Protocol

1. Clean and dry filter holder and place in horizontal position.
2. Place filter in holder, assuring proper position (see filter handling section) and clamp filter in place. For Nuclepore filters at least two 47 mm cellulose acetate (Millipore type HA) filters with 5 μm pore size should be used as support.

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1 Yamate, G. 1981. Illinois Institute of Technology Research Institute. Methodology for the measurement of airborne asbestos by electron microscopy. Draft Report. Research Triangle Park, NC: U.S. Environmental Protection Agency. Contract 68-02-3266.

3. Rotate filter holder such that filter is in a vertical position (perpendicular to ground).
4. Start pump, check to see that filter is not wrinkled,and put top on filter holder.
5. Check plumbing for any leaks and check filter holder to assure that it is free from vibration.
6. Check flow with flowmeter with the timer control set on manual.
7. Set automatic timer to correct date and time and set on/off trippers to desired on-off time settings.
8. Make appropriate logbook entries.
9. Conduct sampling.
10. After sampling period, check flow, leave pump running.
11. Rotate filter to horizontal position, stop pump and remove filter. Attach Millipore or Nuclepore filter to a petri dish with tape and cover with lid for proper handling and transport. Number petri dish.

14.5 Filter Handling Procedures

1. Handle the filters by forceps (not with fingers) during loading and unloading of the filter holders.
2. After sampling, place the exposed filter in the petri holder (Millipore filters) exposed side up and maintain in that position during the handling and transport of the samples to the laboratory.

3. Hand-carry the samples in a container to the laboratories doing the chemical analyses.
4. Handle the container in a way that will keep the petri holders and the Nuclepore filter cassettes in a horizontal (flat) position at all times (handling, transport, and storage).

14.6 Laboratory Blanks

Use filters from the same production lot number, if possible. Prior to field sampling, select six filters (at least one per box) to serve as laboratory blanks and keep in laboratory until analysis. These blanks are used to check that the fibers are not contaminated prior to, or after sampling.

14.7 Field Blanks

During each of the five sampling periods, randomly select one field blank (filter) from a new box of filters at each sampling site (i.e., waste disposal and background sites). This will results in a total of 10 field blanks. Encode and handle the blank filters according to the same protocol as the test filters.

14.8 Log-Book Entries

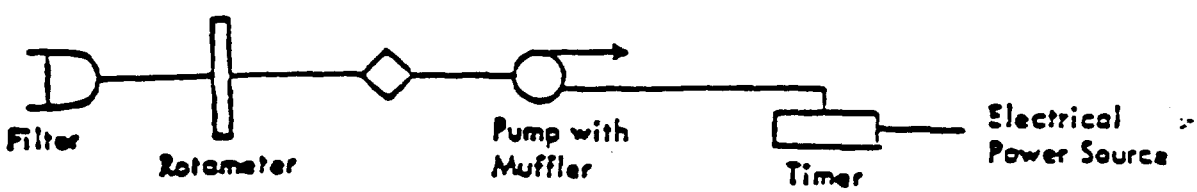
An important part of any field program are the observations and accurate records of the field team. As a minimum, logbook entries shall include:

1. Name of field operator.
2. Date of record.
3. Number and location of site.
4. Position of sampler within site.
5. Brief site description (sketch).
6. Filter number.
7. Identification numbers of pump, timer and filter holder.
8. Sample flow rate at start of sampling period.
9. Start time.
10. Stop time.
11. Sample flow rate at end of sampling period.
12. Wind rose for the sampling period.
13. Description of meteorological conditions.
14. Comments.

14.9 Procedure for Measuring Flow in the Field

This procedure describes the process used to determine the sample flow rates through the filters used to collect asbestos fibers in ambient air:

1. Set up the sampling system as shown below with the rotameter positioned as shown below.



2. Turn on the pump and with the filter in place, record the rotameter reading in the notebook.
3. Turn off the pump and remove the rotameter from the sampler.
4. Reconnect all tubing.
5. The sampler is ready to operate.
6. Repeat procedures 1 through 3 at the end of the sampling period.
7. Calculate the flow as follows:
   a. Using the calibration curve for the rotameter, determine the flow rates for each rotameter reading and record these values on the data sheet.
   b. Calculate the average flow rate for the sampling period using the following equation:

$$\text{average flow rate} = \frac{(\text{initial flow rate} + \text{final flow rate})}{2}.$$

   c. Calculate the actual volume of sample collected by multiplying the average sample rate by the sampling time.

15.0 SAMPLE CUSTODY

Sample traceability procedures described herein will be used to ensure sample integrity.

1. Each sample (filter) shall be issued a unique project identification number as it is removed from the pump. This number shall be recorded in a logbook along with the following information:
   a. Name and signature of field operator.
   b. Lot or assigned batch number (or any other identifiable number).
   c. Filter type (e.g., Millipore, Nuclepore).
   d. Date of record.
   e. Site (background or waste-disposal).
   f. Location of sampler within site.
   g. Use of filter, i.e., field blank, lab blank or test filter.
   h. Condition of sample.
   i. Sample flow rate at start of sampling period.
   j. Start time.
   k. Stop time.
   l. Sample flow rate at end of sampling period.
   m. Any specific instructions/comments.
2. A traceability packing slip shall be filled out in the field.

3. The samples shall be hand-carried to the laboratory responsible for chemical analysis where the package contents shall be inventoried against the traceability packing slip.
4. A copy of the inventory sheets shall be sent to the QA monitor. The original will remain in the field sampling leader's project files. A set of random numbers shall be generated and assigned sequentially to each sample replacing the field identification numbers. The relationship between the two sets of numbers shall be recorded and a copy retained by the QAM. Warning labels (if appropriate) will be affixed.
5. In order to maintain traceability, all transfer of samples (e.g., to other laboratories for QA analysis) shall be recorded in an appropriate notebook. The following information shall be recorded:
   a. The name of the person accepting the transfer, date of transfer, location of storage site, and reason for transfer.
   b. The assigned sample code number, which remains the same regardless of the number of transfers.

After the samples are properly logged in they will be placed in suitable storage areas. These areas will be identified as to the hazard they present to the samples.

16.0 SAMPLE ANALYSIS PROCEDURES

All air samples shall be hand-carried to the laboratory carrying out the chemical analysis and shall be kept encoded during microscopy analyses. They shall be decoded by the QA monitor after all analyses are completed.

Upon receipt of filters the laboratory shall record in a laboratory logbook the sample numbers, date they were received, and any macroscopic identifying characteristcs of particular filter samples. This includes damaged or smudged areas on the filter surface, lack of uniform sample deposition, unattached particulate or debris, unusually heavy-appearing deposit concentration, or other evidence of unusual condition.

Any damaged areas removed prior to sample preparation shall be mounted on glass slides using double-sided adhesive and the diameter of the effective filter area shall be measured. The total effective filter area and damaged areas of sample removed should be accurately recorded for subsequent calculation of asbestos concentrations.

Analysis shall be by transmission electron microscopy according to the methodology recommended by EPA [1,2].

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[1]USEPA. 1978. U.S. Environmental Protection Agency. Electron Microscope Measurement of Airborne Asbestos Concentrations, A Provisional Methodology Manual. Research Triangle Park, NC: Office of Research and Development, U.S. Environmental Protection Agency. EPA-600/2-77-178.

[2]Yamate, G. 1981. Illinois Institute of Technology Research Institute. Methodology for the measurement of airborne asbestos by electron microscopy. Draft Report. Research Triangle Park, NC: U.S. Environmental Protection Agency. Contract 68-02-3226

Two alternative sample preparation protocols are employed. The first is utilized when contamination by nonasbestos materials is not a problem and the sample is collected on polycarbonate Nuclepore filters. The second protocol is employed when the sample is collected on Millipore filters (cellulose acetate). Which protocol is employed will be determined by the outcome of the pretest, as discussed in Section 6.0. Both protocols are described below.

16.1 Sample Preparation

16.1.1 Samples on Millipore Filters

In the original sample dish, cut a 90 radial section of the original 47-mm filter sample with a clean, single-edged razor blade. Transfer the quarter section with stainless steel forceps to a clean 1 in. x 3 in. glass slide, and cut again into smaller wedges to fit into the glass ashing tube (approximately 15-mm long). Transfer the wedges by forceps to clean, numbered ashing tube. Place the tube in an LFE 504 low temperature plasma oven, one sample tube and one laboratory control tube per ashing chamber. The laboratory control tube may either contain a blank Millipore filter or be run as an empty tube. Maintain the ashing process at 450 watts for 2 hr.

Upon removal from the oven, treat the ashing tubes as follows. Place the tube in an ultrasonification bath. Pour 1 to 2 ml of 0.22μm filtered Millipore-Q water into the tube from a

clean 100 ml graduated cylinder. Sonicate (at 40 milliamperes) the sample vigorously for approximately 5 min and transfer it to a clean 150 ml glass beaker. Rinse the tube by additional ultrasonification two or three times more using a few milliliters of filtered water each time, and transfer the contents to a 150 ml sample beaker. Add the remaining volume (up to 100 ml) of filtered water and sonicate again the entire suspended sample or blank, so that the total time of dispersion in the sonicator takes at least 20 min. Use a clean glass rod to stir the suspended sample while it is being sonicated.

Divide the 100 ml fraction into three aliquots: 10, 20, and 70 ml, prepared in that order. Using a 25-mm Millipore filter apparatus, place a 0.1 μm Nuclepore polycarbonate filter on top of an 8.0 μm mixed cellulose ester Millipore backup filter. Wet the filters by aspirating approximately 10 ml of filtered deionized water. Stop aspiration, pour in the first sample aliquot or portion thereof, and begin the aspiration procedure again. Carefully add the remaining sample volume without disturbing the flow across the Nuclepore filter surface. The suspended sample may be resonicated or stirred between filtration of the aliquots.

When the sample is deposited, carefully transfer the Nuclepore filter to a clean, labeled (sample number, date, and aliquot size) 1 x 3 in glass slide. Discard the Millipore backup filter.

When dry, attach the 0.1 μm Nuclepore filter tautly to the slide with transparent tape. Coat the filter with an approx-

imately 40-nm-thick carbon film (national Spectroscopic Laboratories carbon rods) by vacuum evaporation. The film thickness need be sufficient only to provide support for the deposit sample.

Transfer the polycarbonate filter deposit to a 200-mesh electron microscope copper grid (E. G. Fullam) by first cutting a 3-mm-square portion from the filter using a clean, single-edged razor blade. Place this deposit side down on the electron microscope (EM) grid which, in turn, has been set upon a small, correspondingly labeled portion of lens tissue paper. Place the film, grid, and lens paper on a Jaffe dish consisting of a copper screen supported on a bent glass rod in a covered 90-mm glass petri dish. Pour reagent grade chloroform (J.T. Baker Company) into the dish to saturate the lens paper without submersing the grid and sample. Keep the dish covered at room temperature for 2 hr. Shift the prepared sample to a clean petri dish with fresh chloroform. Heat to 40° C for 10 min to provide a washing procdure.

While it is still wet, place the sample grid in a small gelatin capsule. Tape the capsule to the slide that has the remaining coated polycarbonate filter, and store until analysis.

16.1.2 Samples on Nuclepore Filters

The above ashing and refiltering procedures are unnecessary for samples collected directly on Nuclepore filters. Instead, the filter is carbon-coated and transferred to an EM grid as described in the preceding three paragraphs.

16.2 Microscopic Procedure

Select a sample or, for samples ashed and refiltered, start with the 70-ml aliquot of filtered material. Examine the EM grid under low magnification in the transmission electron microscope to determine its suitability for examination under high magnification. Ascertain that the loading is suitable and is uniform, that a high number of grid openings have their carbon film intact, and that the sample is not contaminated excessively with extraneous debris or bacteria.

Scan the EM grid at a screen magnification of 20,000X. Record the length and breadth of all fibers that have an aspect ratio of greater than 3:1 and have substantially parallel sides. Observe the morphology of each fiber through the 10X binoculars and note whether a tubular structure characteristic of chrysotile asbestos is present. Switch into selective area electron diffraction (SAED) mode and observe the diffraction pattern. Note whether the pattern is typical of chrysotile or amphibole, ambiguous, or neither chrysotile nor amphibole. Use energy dispersive X-ray analysis where necessary to further characterize the fiber. Take pictures as desired representing the sample type, fiber/particulate distribution, or characteristic SAED patterns of chrysotile and specific amphibole types.

Count the fibers in the grid openings until at least 100 fibers, or the fibers in a minimum of 10 grid openings, have been counted. Once counting of fibers in a grid opening has started, the count shall be continued though the total count of fibers may be greater than 100.

To ensure uniformity of grid opening dimensions, examine several 200-mesh grids by optical microscopy and measure roughly 100 opening per grid. Average these dimensions to provide a standard grid opening area.

16.3 Calculations

Calculate from the following equation, fiber number concentration expressed as the total number of fibers/volume of air:

$$\text{Fiber counts } (f/m^3) = (\text{number of fibers counted})\ (\text{area factor}^*)\left(\frac{\text{dilution factors}^{**}}{\text{volume sampled, } m^3}\right)$$

Calculate fiber mass for each type of asbestos in the sample by assuming that the breadth measurement is a diameter; thus, the mass can be calculated from:

$$\text{Mass } (\mu g) = \frac{\pi}{4} \cdot (\text{length, } \mu m) \cdot (\text{diameter, } m)^2 \cdot (\text{density, } g/cm^3) \cdot 10^{-6}$$

The density of chrysotile is assumed to be 2.6 g/cm^3, and of amphibole, 3.0 g/cm^3. The mass concentration for each type of asbestos is then calculated from:

$$\text{Mass Concentration } (\mu g/m^3) \text{ of a Particular Type} = \frac{\left(\text{Total Mass of All Fibers of that Type } (\mu g)\right)(\text{area factor}^*)\ (\text{dilution factors}^{**})}{\text{Volume of Air Sampled } (m^3)}$$

$$^*\text{Area factor} = \frac{(\text{total effective filter area, } cm^2)}{(\text{number of grids examined})\ (\text{average area of an EM grid opening, } cm^2)}$$

**Dilution factors take into account sample dilution during ashing and refiltering and transfer to the EM grid. The factor = 1.0 for samples collected on Nuclepore filters. For the samples collected on Millipore filters, the factor = [(proportion of original filter ashed) (aliquot volume, cm^3/100 cm^3)].

Record the fiber bundles and clusters as such, but do not include them in the mass calculation or the fiber count. The fiber clusters and fiber bundles are not included in the mass calculation because (1) it is difficult to assign the third dimension to the two-dimensional observation of the aggregates, (2) it is difficult to determine void space within bundles and clusters, and (3) since the bundles and clusters make up only about 2% of the item count, one cannot be certain of the even distribution throughout the filter.

16.4 Field Blanks

From the 10 field blanks, three shall be randomly selected by the QA monitor for chemical analysis to check for contamination. These three filters shall consist of one filter from the background site, and two from the waste-disposal site. The remaining 7 field blanks shall be kept for additional analyses, if necessary. If field blank contamination is detected, it may be appropriate to analyze one or more factory blanks to check whether the filters were contaminated prior to being taken into the field.

16.5 External Quality Assurance Filter Analysis

As a quality assurance measure, the QA monitor shall randomly select three samples to be analyzed by an external certified laboratory (QA laboratory). All filters selected for QA analysis shall be divided in half according to the analytical

protocol for air samples and one half of each filter shall be hand-carried to the QA Laboratory. In addition, three laboratory blanks will be sent to the QA Laboratory and at least one of these will be analyzed by the QA Laboratory (see Section 16.7). The results from the QA laboratory will be compared with those from the primary laboratory. If serious discrepancies appear, additional filters should be analyzed.

16.6 Replicate and Duplicate Filter Analyses

As a means of quantifying in-house variability, and analytical variability introduced by the filter preparation procedure, samples shall be selected by the QA monitor for replicate and duplicate analyses. Replicate analysis shall be performed using two independent preparations from the same filter. Duplicate analyses shall be conducted by a second analyst using the same grid preparation as in the original analysis. For this purpose, filters shall be randomly selected from the remaining filters (i.e., those not chosen for external QA analysis). Three filters shall be selected for duplicate analyses and three for replicate analyses.

16.7 Laboratory Blanks

As a means of checking on possible contamination during the preparation procedures, at least three laboratory blank filters should be subjected to standard laboratory procedures during preparation and analysis of the samples. At least one of these

is then analyzed to check for contamination in the laboratory. This procedure should be followed at both the main laboratory and at the external QA laboratory.

Table 2. Number and Types of Chemical Analyses

		Field blank		Test filters		
	Laboratory blanks	Background	Waste-Disposal	Background	Waste-Disposal	Total
Filters available for analysis	6	5	5	5	25	30
Filters actually analyzed	2[a]	1	2	5	25	30
Filters for external QA	See above					3
Filters for replicate analysis						3
Filters for duplicate analysis						3
Total number of chemical analysis	2	1	2			39

[a] One by main laboratory and one by external QA laboratory.

17.0 ROTAMETER CALIBRATION PROCEDURES AND REFERENCE MATERIALS

17.1 Rotameter Calibration Procedure

1. Record the preliminary data at the top of the data sheet shown in Figure 2.
2. Set-up the calibration system as shown in Figure 3. Allow wet test meter to run for 20 min. before starting the calibration.
3. Turn on the pump and adjust the flow until the pyrex ball is around 25 on the rotameter scale.
4. Record both the SS and pyrex ball values on the data sheet.
5. Measure the volume of air which passes through the rotameter during an accurately timed interval. Record the initial and final times and wet test meter readings.
6. Record the wet test meter temperature (Tw) and manometer readings (ΔP) during the time interval.
7. Run at least duplicates for each rotameter setting.
8. Reset the pyrex ball to around 90 and repeat Steps 4 through 7.
9. Reset the pyrex ball to around 120 and repeat Steps 4 through 7.
10. Calculate flow rates for each setting using the equation:

$$Q = \frac{(Vw \times Corr)}{Time} \left[\frac{(P_b - V_p) + \frac{\Delta p}{13.6}}{P_s} \right] \left[\frac{T_s}{T_w + 273} \right]$$

Flowmeter type _____ Tube _____

I.D. no. _____ Date _____

Barometric pressure, P_b _____ "H_2O Initial _____

Standard pressure, P_s _____ "H_2O Standard temp, T_s _____ ° K

Test no.	Flowmeter ball, mm		Wet test meter (corr. =)					Q^b
	SS	Pyrex	Time min	Vw cc	ΔP "H_2O	Tw °C	Vp^a "Hg	Flowrate Std cc/min

[a] From vapor pressure vs. temperature tables

$$^bQ = \frac{(Vw \times Corr.)}{Time}\left[\frac{(P_b - Vp + \left(\frac{\Delta P}{13.6}\right)}{P_s}\right]\left(\frac{T_s}{Tw + 273}\right)$$

FIGURE 2. FLOWMETER CALIBRATION DATAFORM, > 1000 cc/min

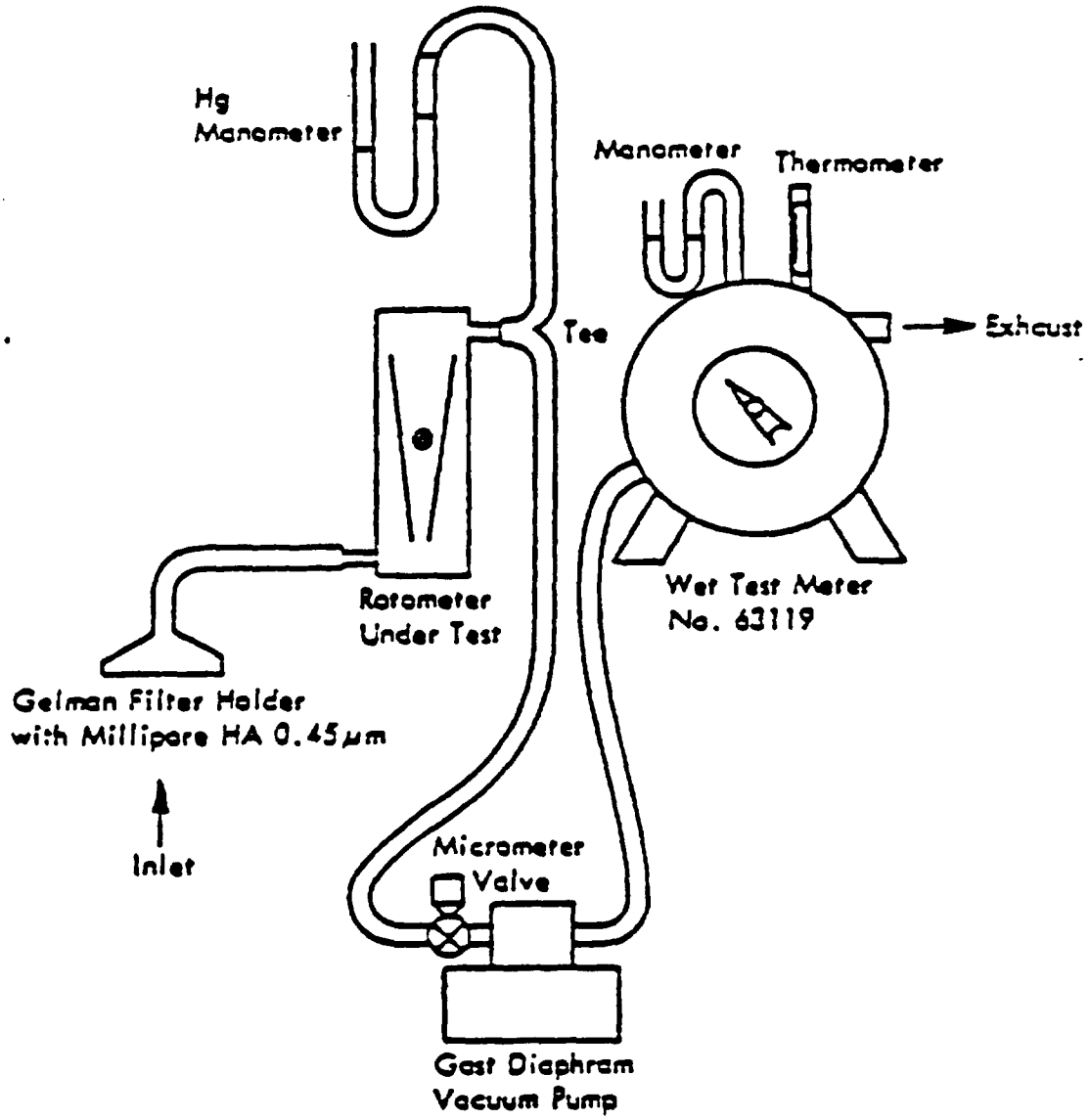


FIGURE 3. ROTAMETER CALIBRATION SYSTEM

where:

Q = flow rate in standard cc/min,

V_w = wet test meter volume in cc,

Corr. =correction value obtained for each specific we test meter,

Time =time in minutes,

P_b =barometric pressure in inches of H_2O,

V_p =vapor pressure in inches of H_g,

Δp =manometer reading in inches of H_2O,

P_s =standard pressure in inches of H_2O,

T_s =standard temperature in ^oK, and

T_w =wet test meter temperature in ^oC.

10. Plot rotometer readings versus values of Q for each setting as shown in Figure 4.

17.2 Rotameter Calibration Schedule

Rotameters shall be checked, cleaned if necessry, then calibrated prior to the first sampling trip.

17.3 Reference Materials

Standard materials of known asbestos type shall be used as references for fiber morphology and electron diffraction patterns.

Subject to availability, National Bureau of Standards standard filter preparations of known asbestos concentration will be used to assess the accuracy of the TEM method.

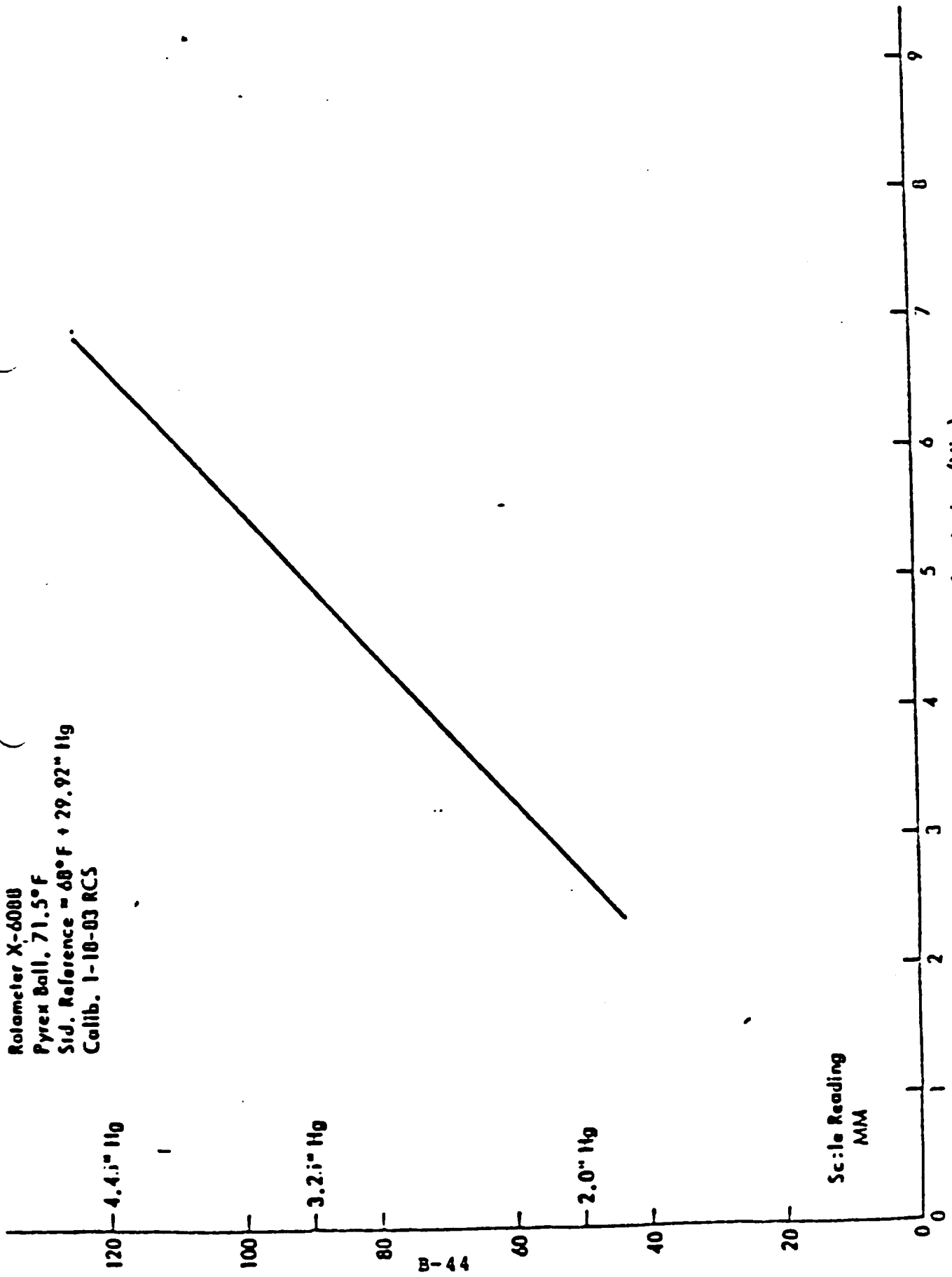


FIGURE 4. PLOT OF ROTAMETER READINGS VERSUS VALUES OF Q

18.0 DATA VALIDATION

As a minimum, the guidelines listed below should be followed:

- When calculations are made by hand, 2 people shall spot check some calculations independently and then compare results; correct, if necessary.
- When computer is used, data entry shall be verified; programs, formulae, etc..., shall be tested with sample data previously worked out by hand.
- When statistical software packages are used, tests of reason shall be applied; on outputs, double-check sample sizes, degrees of freedom, variable codes, etc...; be alert for outliers.
- When reporting numerical results, computer generated outputs rather than retyped tables shall be used to the extent possible. When possible, reported tables shall be compared for consistency in variable codes and values, sample sizes, etc...

In all cases, data validation activities shall be documented and records kept of any necessary corrective action in the appropriate notebook.

19.0 DATA PROCESSING AND ANALYSIS

Standard statistical techniques will be used to estimate mean airborne asbestos concentration for the waste disposal site and for the background site. A 95% confidence interval will be obtained to provide a measure of the error involved in the estimation. Comparisons between the disposal site and background concentrations will be made.

Power calculations shall be made to indicate the power of the statistical tests to detect differences between means.

The results from the various QA analyses (field blanks, external laboratory, replicate and duplicate analyses) will be compared with the appropriate original analyses. The small number of QA samples precludes formal statistical analysis. However, if inconsistencies or large discrepancies are observed, further QA samples can be analyzed since only a portion of each filter is needed for each analysis.

20.0 INTERNAL QUALITY CONTROL CHECKS

Internal quality control is achieved by the use of

- laboratory blanks (filters)
- field blanks (filters)
- external laboratory QA analyses
- replicate analyses
- duplicate analyses
- data entry checks
- data transfer checks

as described in Sections 14, 16 and 18.

21.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits provide the primary means for external monitoring for this project. These audits will be performed during the field sampling by an individual appointed by the QA monitor.

21.1 Performance Audits

Device to be Audited	Audit Device
Diaphragm pump	Calibrated rotameter

* Performance Audit Procedure
  - Verify calibration of the rotameter against standard reference device.
  - Review EPA standard methods and/or other test protocols.
  - Directly measure flow rate against rotameter.
  - Record all data on performance audit form. In general, all reported values should be within ± 10% as compared to the audit device.
  - Prepare and submit a summary report, and all records to the QA monitor.

21.2 System Audit

Area to be Audited	Audit Mechanism
Entire Sampling Procedure	Standard Audit Form

* System Audit Procedure
  - Review test procedures and protocols.
  - Obtain standard audit form.
  - Observe the performance of each task.
  - Ask questions as required.
  - Take corrective actions as necessary.
  - Fill in appropriate blank lines on audit form.
  - Prepare and submit summary report, and all records to QA monitor.

22.0 DATA ASSESSMENT PROCEDURES

Precision of the data will be determined by performing replicate analyses or replicate sample preparation and analyses operations. The measurement for precision will be the coefficient of variation (standard deviation/mean). Tests for outliers will be performed on data obtained from the primary laboratory. Data from both the primary and external QA laboratories will be compared and checked for discrepancies.

23.0 FEEDBACK AND CORRECTIVE ACTION

The types of corrective action procedures which will be used for this program are:

- On-the-spot, immediate, corrective action.
- Closed-loop, long-term, corrective action.

23.1 On-the-Spot Corrective Action

This type of corrective action is usually applied to spontaneous, non recurring problems, such as an instrument malfunction. The individual who detects or suspects non-conformance to previously established criteria or protocol in equipment, instruments, data, methods, etc., immediately notifies his/her supervisor. The supervisor and the appropriate task leader then investigate the extent of the problem and take the necessary corrective steps. If a large quantity of data is affected, the task leader must prepare a memo to the Project Manager and the Quality Assurance Monitor. These individuals will collectively decide how to proceed. If the problem is limited in scope, then the task leader decides on the corrective action measure, documents the solution in the appropriate workbook and notifies the Project Manager, and the QA monitor in memo form.

23.2 Closed-Loop, Long-Term Corrective Action

Long-term, corrective action procedures are devised and implemented in order to prevent the re-occurrence of a potentially serious problem. The QAM is notified of the problem and conducts an investigation of the problem to determine its severity and extent. The QAM then files a corrective action request with the appropriate Task Leader, with a copy to the Project Manager, requesting that corrective measures be put into place. Suggestions as to the appropriate corrective action will also be made. The Task Leader is responsible for implementing any corrective actions. The QAM will conduct a follow-up investigation to determine the effectiveness of the corrective action.

24.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

In general, monthly summary reports to management shall include information from:

- Inspections, performance audits and/or systems audits.
- Reports and/or findings of irregularities or non-conformance to program quality policies.
- Status of solutions to any problem area.

Procedurally, the QA Monitor will prepare the reports to management. These reports will be addressed to the Project Manager and the QA administrator. The summary of findings shall be factual, concise and complete. Any required supporting information will be appended to the report.

25.0 REPORT DESIGN

The project report will contain the following sections:

(1) Executive Summary

(2) Overview of the Experimental Design

- Background
- Purpose and Objectives
- Experimental Design

(3) Description of the Results

(4) Conclusions and

(5) Methodological Report

- Experimental Design
- Sampling Procedures
- Chemical Analysis
- Statistical Analysis
- Data and Data File Documentation

This QA plan will be included as appendix together with documentation of any deviations from the plan. Results of analyses of external QA, replicate and duplicate analyses will be presented and discussed.

EXHIBIT 2

SPECIFICATIONS

FOR

GEOTECHNICAL AND HYDROLOGICAL INVESTIGATION

OF THE

WASTE DISPOSAL SITE STUDY

AT

JOHNS-MANVILLE SALES CORPORATION
WAUKEGAN, ILLINOIS PLANT

PROJECT: S94-3224

Prepared by: Manville Service Corporation
P. O. Box 5108
Denver, CO 80217

June 1, 1984
Submitted to Illinois EPA and USEPA

0610W

C610W
8/1/24

GEOTECHNICAL AND HYDROLOGICAL INVESTIGATION SPECIFICATIONS

Waukegan - Waste Disposal Site Study
Project S94-3224

1.0 Scope of Work

1.1 The field work area for this investigation shall be confined to the Johns-Manville Sales Corporation, Waukegan, Illinois plant property as shown on contract drawings listed below.

Contract Drawings

Dwg. No.	Title	Remarks
A36121-4	Proposed Groundwater Monitoring Well Locations	
A36122-4	Proposed Soil Sampling Locations	
A42000-1	Topographic Map Waste Disposal Site Study	The Sidewell Co. dwg Job No. T2-020

1.2 The geotechnical and hydrological investigation shall consist of the following phases:

1.2.1 Work Plan Preparation.

This phase should include the following items:

1.2.1.1 Site Health and Safety Plan.

1.2.1.2 Quality Assurance Project Plan.

1.2.1.3 Field Protocols.

1.2.1.4 Subcontractor Procurement.

1.2.1.5 Site Safety and Decontamination Facilities.

The initial site visit portion normally associated with this phase will be completed during bidding phase prior to issuance of contract.

See paragraphs 1.3 and 1.4 for submittal requirements.

1.2.2 Soil Sampling and Analysis.

1.2.3 Groundwater Monitoring Well Installation.

1.2.4 Groundwater Quality Sampling and Analysis.

1.2.5 Preparation and Submittal of Technical Report.

The report shall include the technical memorandums for the soil and water sampling and analysis.

1.3 Within thirty (30) days from award of contract and prior to the initiation of any site work, the Consultant shall submit to the Owner, Illinois EPA, and USEPA for approval of the following documents and/or plans:

1.3.1 Site Health and Safety Plan.

1.3.2 Quality Assurance Project Plan.

1.3.3 Field Protocols.

1.3.4 Site Safety and Decontamination Facilities.

1.4 Prior to the initiation of any site work, the Consultant shall submit to the Owner only for approval of the following documents and/or plans:

1.4.1 Subcontractor Procurement.

2.0 Work Not Included

2.1 Site Data

The collection and cataloging of existing site data to develop a bibliography of the existing disposal site. The necessary information for this function will be provided by the Owner.

2.2 Topographic Survey

A recent topographic map will be provided by the Owner. See contract drawing list.

2.3 Warning Sign Installation

The installation of warning signs will be completed under separate contract issued by the Johns-Manville Waukegan Plant.

3.0 Site Health and Safety Plan

Prior to the initiation of any on-site drilling, several items shall be provided and/or procedures established by the Consultant. The work under this section shall consist of the following:

3.1 Documentation of Field Data and Laboratory Work.

Standard forms shall be required for boring logs, chain of custody records, field and laboratory notebooks, sample labels, etc.

3.2 Site Safety

Site safety program shall be developed in accordance with approved operating procedures. These procedures shall be distributed to all field personnel including subcontractors. Standard safety practices for drilling shall be adhered to including periodic checking of equipment.

3.3 Emergency Procedures

A person shall be required on-site at all times that is trained in emergency first aid. Arrangements shall be made in advance for emergency medical treatment, posting telephone numbers for emergency and ambulance services, and name, directions, telephone number of nearest medical facilities.

3.4 Personnel Protective Equipment

See Site Safety Decontamination Facilities, paragraph 7.0, page 5 of the specifications.

3.5 Weather

Under extreme weather conditions, an assessment shall be made for the necessity of additional protection and/or monitoring of personnel (e.g., for heat stress).

3.6 A decontamination program shall be established for personnel leaving the disposal site.

3.7 The Site Health and Safety Plan shall be consistent with and work performed shall comply with the following:

3.7.1 USEPA - Occupational Health and Safety Manual

3.7.2 USEPA Order 1440.1 - Respiratory Protection

3.7.3 USEPA Order 1440.3 - Health and Safety Requirements for Employees Engaged in Field Activities

3.7.4 USEPA - Interim Standard Operating Safety Guides

3.7.5 Illinois Occupational Safety and Health Act

3.7.6 Actual disposal site conditions

4.0 Quality Assurance Project Plan

4.1 The Consultant shall develop a quality assurance project plan for the sampling, analysis, and data handling of the various soil and water samples. The plan shall be consistent with the requirements of:

4.1.1 USEPA QAMS-005/80 Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans

4.2 The Consultant shall use acceptable Q.A./Q.C. programs. Specific items of concern that shall be satisfactorily complied with as follows:

4.2.1 Equipment shall be maintained and calibrated at regular intervals.

4.2.2 Procedures for sampling shall follow ASTM methods and/or adhere to EPA guidelines.

4.2.3 Standard field notebooks shall be used during sampling to record all information and observations.

4.2.4 Work shall be carried out only by qualified personnel.

4.2.5 Sample custody shall be documented by the Consultant's procedures while in-house, and by EPA guidelines outlined "Test Methods for Evaluating Solids Waste (EPA-SW-846, 1980)" as necessary. In addition overall sample custody shall comply with paragraph 4.1.1 above.

5.0 Field Protocols

The Consultant shall develop field protocols for various situations that may occur during the field phase. Situations to plan for but not limited to:

5.1 Decontamination of equipment, and sampling equipment between sampling.

5.2 Disposal procedures of any contaminated soils, ground waters, etc.

5.3 Hole abandonment procedures.

5.4 Procedures to be taken if any dangerous vapors, ie. xylene, etc., are encountered during drilling.

6.0 Sub-Contractors Procurement

The Consultant shall submit the required documents to their prospective sub-contractors for bidding various work to be sub-contracted. Consultant shall submit the name/s of sub-contractor/s and scope of work to be performed for approval by the Owner.

7.0 Site Safety Decontamination Facilities

7.1 The Consultant shall provide site safety and decontamination facilities. A combination decontamination and office trailer shall be supplied for site use by all field personnel. In addition, personal air samplers shall be worn by all field personnel to monitor airborne asbestos. Filters will be analyzed for asbestos fibers.

7.2 It is assumed that the site health and safety assessment recommends Level C protection for all on-site activities. The Consultant shall use disposable personal protective clothing and decontamination materials.

8.0 Site Survey

8.1 The Consultant shall retain a registered Illinois land surveyor to provide temporary on-site bench marks from which drill crews shall establish locations and surface elevations of each boring. The survey tolerance shall be as follows:

8.1.1	All boring locations:	Horiz. - ± 1 ft.
8.1.2	Ground water monitoring wells,	Vert. Elev - ± 0.01 ft.
8.1.3	Soil borings,	Vert. Elev. - ± 0.1 ft

8.2 The actual location of the borings per drawings to be within one (1) foot ± in any horizontal direction due to ongoing activities at the site and/or nature of the waste fill material.

9.0 Soil Sampling and Analysis

9.1 The Consultant shall determine whether the surface, near surface, and subsurface soils are contaminated with hazardous substances. This shall include samples from both fill materials and natural underlying soils where practical.

9.1.1 Disposal on-site and perimeter (non-disposal areas) soil samples shall be analyzed for the presence of substances identified in paragraph 9.2. Representative surface and near-surface soil samples could be obtained with a solid-stem hand auger.

9.1.2 Surface and near-surface samples shall be taken at 0.0 to 0.5 foot and 1.0 to 1.5 feet typically at four (4) places at each location. At each of these boring locations, a composite sample shall be made of the four surface samples and another composite sample shall be made of the four near-surface samples. The proposed on-site and perimeter sampling locations are shown on contract drawings. Sampling equipment shall be decontaminated between samples.

9.1.3 From the disposal on-site soil borings, representative subsurface samples shall be obtained at two and one-half (2.5) foot intervals in the waste fill material using a standard split-spoon sampler until the natural ground is reached. In order to minimize the possibility of contaminating the underlying natural soils, the soil borings through the waste fill material shall, to the extent possible, not penetrate into the underlying natural soils. Upon field determination of the total depth of waste fill material at each boring hole, USEPA will determine, in consultation with the Owner, the percentage of the fill samples to be analyzed. The remainder shall be properly stored for future analysis if required.

9.1.4 Continuous sampling from the perimeter (non-disposal areas) soil boring holes shall be obtained to a depth of thirty (30) feet below the lowest level of waste deposition.

9.1.5 The soil borings shall be made with a standard 6 1/4" O.D. hollow stem auger. Sample shall be obtained using split spoon sampling or thin wall tubes, as field conditions permit, following ASTM procedures.

9.1.6 All sampling and testing shall conform to guidelines in the User's Guide to the USEPA Contract Laboratory Program (CLP) prepared by the Sample Management Office of CLP and published in August 1982.

9.1.7 Cuttings can be disposed of on site.

9.1.8 All samples and data obtained should be stored for twelve (12) months after completion of laboratory work. The Owner shall be notified prior to disposing of the samples.

9.2 Soil samples would be analyzed for:

9.2.1 Asbestos fibers

9.2.2 Engineering properties (sieve, specific gravity, moisture content, Atterberg limits, permeability).

9.2.3 Inorganic Analysis Data Sheet (Table 1)

9.2.4 Organic Analysis Data Sheet (Table 2)

Non-priority pollutant hazardous substances list compounds may be deleted except for Xylene.

9.2.5 Thiram

9.3 A technical memorandum describing the soil sampling and analysis program shall be prepared. The technical memorandum shall include a description of the sampling procedure, a summary of the laboratory test results, and copies of the laboratory data sheets. Five (5) copies of the technical memorandum shall be submitted to the Owner and Illinois EPA, and USEPA.

9.4 For the purpose of completing a bid estimate, the following assumptions can be used for estimated quantities:

9.4.1 Three hundred (300) lineal feet (10 boring locations x 30' depth each) of soil borings. This will include one hundred and twenty (120) lineal feet of continuous soil sampling, 4 perimeter (non-disposal areas) holes x 30' depth.

9.4.2 Two (2) composite samples from each soil boring location shall be taken per paragraphs 9.1.1 and 9.1.2.

9.4.3 Ten (10) surface and near-surface soil samples listed in paragraph 9.4.2 above shall be analyzed per paragraph 9.2.

9.4.4 Seventy-six (76) sub-surface soil samples shall be taken. Breakdown of these samples as follows.

9.4.4.1 Seventy-two (72) samples from six (6) soil boring holes in the waste fill material, 12 samples per hole (30' depth - 2.5' intervals).

9.4.4.2 Four (4) samples, one sample each from the perimeter (disposal off-site) soil boring holes.

9.4.5 Sixteen (16) subsurface soil samples shall be analyzed per paragraph 9.2. The samples shall consist of twelve (12) waste fill material samples (2 samples per 6 disposal on-site holes) and four (4) natural soil samples per paragraph 9.4.4.2 above.

9.4.6 Site sampling team consists of one engineering geologist/geotechnical engineer/hydrogeologist, and two technicians.

10.0 Groundwater Monitoring Well Installation

10.1 The Consultant shall install groundwater monitoring wells at locations shown on the contract drawings.

10.2 These wells shall be used to determine whether the near surface groundwater is contaminated with hazardous substances.

10.2.1 Groundwater monitoring wells will not be drilled through waste fill material and/or installed in the disposal on-site area.

10.2.2 The perimeter (non-disposal areas) wells shall be drilled and screened so as to monitor the upper most portion of the shallow aquifer..

10.3 Screen positions shall be determined in the field based on the subsurface conditions.

10.4 The monitoring wells shall be constructed in compliance with Federal and State regulations. Well drilling and installation shall be logged and inspected by a qualified hydrogeologist/geotechnical engineer/engineering geologist.

General requirements are:

10.4.1 All drilling equipment, pipe, and materials shall be decontaminated before drilling.

10.4.2 Eight (8) inch minimum diameter boreholes shall be drilled with a hollow stem auger or cable tool drill rig.

10.4.3 A continuous sample of the natural ground shall be taken in each well for the purpose of a geological log. No soil samples will be required for chemical nor engineering properties analyses from the ground water monitoring well sites.

10.4.4 The monitoring wells shall be constructed as per details attached to these specifications.

10.4.5 Wells shall be developed with air, bailing, or surging techniques after installation.

10.4.6 All drilling equipment, pipe, and materials shall be decontaminated before proceeding to the next hole.

10.4.7 Top of casing and stable groundwater elevations shall be obtained for all wells to within 0.01 foot.

10.4.8 Field hydraulic conductivity tests shall be conducted on some wells if aquifer characteristics permit.

10.4.9 All groundwater samples and data obtained shall be stored for twelve (12) months after completion of laboratory work. The Owner shall be notified prior to disposing of the samples.

10.5 A technical memorandum describing the groundwater monitoring well installation shall be prepared. The technical memorandum shall include a description of the drilling, installation of wells, a summary of the field test results, and a map of the water table elevations (a potentiometric ground water map). Five (5) copies of the technical memorandum shall be submitted to the Owner, Illinois EPA, and USEPA.

10.6 For the purpose of completing a bid estimate, the following assumptions can be used for estimated quantities:

10.6.1 One hundred and fifty (150) lineal feet of drilling and well installation, five (5) perimeter (disposal off-site) wells x 30 lf each. This includes one hundred and fifty (150) lineal feet of continuous soil sampling.

10.6.2 Site drilling and sampling team consists of one engineering geologist/geotechnical engineer/ hydrogeologist, and two technicians.

10.6.3 Field hydraulic conductivity tests and groundwater elevation measurements shall be performed by site sampling team personnel.

10.6.4 All water used or discharged in the drilling process and all drill cuttings can be disposed of on site.

11.0 Groundwater Quality Sampling and Anaylsis

11.1 The Consultant shall provide water quality data for determining whether the groundwater is contaminated with hazardous substances. Water quality samples shall be analyzed for the presence of substances identified in paragraph 11.2. Representative samples shall be obtained from each new monitoring well. Sampling equipment shall be decontaminated between samples. All sampling and testing shall conform to guidelines in the User's Guide to the US EPA CLP prepared by the Sample Management Office of CLP and published in August 1982.

11.2 Groundwater samples shall be analyzed for:

11.2.1 Asbestos fibers

11.2.2 Inorganic Analysis Data Sheet (Table 1)

11.2.3 Organic Analysis Data Sheet (Table 2)

Non-priority pollutant hazardous substances list compounds may be deleted except of Xylene.

11.2.4 Thiram

11.3 A technical memorandum describing the groundwater sampling and analysis program shall be prepared. The memorandum shall recommend whether or not additional groundwater wells and sampling may be required based on the findings. The technical memorandum shall include a description of the sampling procedure, a summary of the laboratory test results, and copies of the laboratory data sheets. Five (5) copies of the technical memorandum shall be submitted to the Owner, Illinois EPA, and USEPA.

11.4 For the purpose of completing a bid estimate, the following assumptions can be used for estimated quantities:

11.4.1 Two (2) groundwater samples shall be taken from each well. Five (5) groundwater samples , one from each well, shall be analyzed per paragraph 11.2.

11.4.2 Site sampling team consists of one geotechnical engineer/engineering geologist/hydrogeologist, and two technicians.

11.4.3 All water purged from the wells during the sampling can be disposed of on site.

TABLE 1

Sample No.

INORGANICS ANALYSIS DATA SHEET

LAB NAME _____ CASE NO. _____

LAB SAMPLE ID. NO. _____ QC REPORT NO. _____

TASK 1 (Elements to be Identified and Measured)

		ug/l or mg/kg (circle one)
1.	Aluminum	
2.	Chromium	
3.	Barium	
4.	Beryllium	
5.	Cobalt	
6.	Copper	
7.	Iron	
8.	Nickel	
9.	Manganese	
10.	Zinc	
11.	Boron	
12.	Vanadium	
13.	Silver	

TASK 2 (Elements to be Identified and Measured)

		ug/l or mg/kg (circle one)
1.	Arsenic	
2.	Antimony	
3.	Selenium	
4.	Thallium	
5.	Mercury	
6.	Tin	
7.	Cadmium	
8.	Lead	

TASK 3 (Elements to be Identified and Measured)

		ug/l or mg/kg (circle one)
1.	Ammonia	
2.	Cyanide	
3.	Sulfide	

COMMENTS:

TASLE 2

Sample Number

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: _____ Case No: _____

Lab Sample I.D. No: _____ QC Report No: _____

Multiply Detection Limits by 1 ☐ or 10 ☐ (Check Box for Appropriate Factor)

ACID COMPOUNDS

EPP #	CAS #		ug/l or ug/kg (circle one)
(21A)	88-06-2	2,4,6-trichlorophenol	
(22A)	-9-30-7	p-chloro-m-cresol	
(25A)	95-57-8	2-chlorophenol	
(31A)	120-83-2	2,4-dichlorophenol	
(34A)	105-67-9	2,4-dimethylphenol	
(37A)	88-75-5	2-nitrophenol	
(38A)	100-02-7	4-nitrophenol	
(39A)	51-28-5	2,4-dinitrophenol	
(40A)	534-52-1	4,6-dinitro-2-methylphenol	
(41A)	87-86-5	pentachlorophenol	
(42A)	108-95-2	phenol	

BASE/NEUTRAL COMPOUNDS

(1B)	83-32-9	acenaphthene	
(2B)	92-87-5	benzidine	
(3B)	120-82-1	1,2,4-trichlorobenzene	
(4B)	118-74-1	hexachlorobenzene	
(5B)	67-72-1	hexachloroethane	
(6B)	111-44-4	bis(2-chloroethyl)ether	
(7B)	91-58-7	2-chloronaphthalene	
(8B)	95-50-1	1,2-dichlorobenzene	
(9B)	541-73-1	1,3-dichlorobenzene	
(10B)	106-46-7	1,4-dichlorobenzene	
(11B)	91-94-1	3,3'-dichlorobenzidine	
(12B)	121-14-2	2,4-dinitrotoluene	
(13B)	606-20-2	2,6-dinitrotoluene	
(14B)	122-66-7	1,2-diphenylhydrazine	
(15B)	206-44-0	fluoranthene	
(16B)	7005-72-3	4-chlorophenyl phenyl ether	
(17B)	101-55-3	4-bromophenyl phenyl ether	
(18B)	39638-32-9	bis (2-chloroisopropyl) ether	
(19B)	111-91-1	bis (2-chloroethoxy) methane	
(20B)	87-68-3	hexachlorobutadiene	
(21B)	77-47-4	hexachlorocyclopentadiene	
(22B)	78-59-1	isophorone	
(23B)	91-20-3	naphthalene	
(24B)	98-95-3	nitrobenzene	
(25B)	86-30-6	N-nitrosodiphenylamine	
(26B)	621-64-7	N-nitrosodipropylamine	
(27B)	117-81-7	bis (2-ethylhexyl) phthalate	
(28B)	85-68-7	butyl benzyl phthalate	
(29B)	84-74-2	di-n-butyl phthalate	
(30B)	117-84-0	di-n-octyl phthalate	
(31B)	84-66-2	diethyl phthalate	
(32B)	131-11-3	dimethyl phthalate	
(33B)	56-55-3	benzo(a)anthracene	

BASE/NEUTRAL COMPOUNDS

EPP #	CAS #		ug/l or ug/kg (circle one)
(34B)	50-32-8	benzo(a)pyrene	
(35B)	205-99-2	benzo(b)fluoranthene	
(36B)	207-08-9	benzo(k)fluoranthene	
(37B)	218-01-9	chrysene	
(38B)	208-96-8	acenaphthylene	
(39B)	120-12-7	anthracene	
(40B)	191-24-2	benzo(ghi)perylene	
(41B)	86-73-7	fluorene	
(42B)	85-01-8	phenanthrene	
(43B)	53-70-3	dibenz(a,h)anthracene	
(44B)	193-39-5	indeno(1,2,3-cd)pyrene	
(45B)	129-00-0	pyrene	

VOLATILES

(2V)	107-02-8	acrolein	
(3V)	107-13-1	acrylonitrile	
(4V)	71-43-2	benzene	
(5V)	56-23-5	carbon tetrachloride	
(7V)	108-90-7	chlorobenzene	
(10V)	107-06-2	1,2-dichloroethane	
(11V)	71-55-6	1,1,1-trichloroethane	
(13V)	75-34-3	1,1-dichloroethane	
(14V)	79-00-5	1,1,2-trichloroethane	
(15V)	79-34-5	1,1,2,2-tetrachloroethane	
(16V)	75-00-3	chloroethane	
(19V)	110-75-8	2-chloroethylvinyl ether	
(23V)	67-66-3	chloroform	
(29V)	75-35-4	1,1-dichloroethene	
(30V)	156-60-5	trans-1,2-dichloroethene	
(32V)	78-87-5	1,2-dichloropropane	
(33V)	10061-02-6	trans-1,3-dichloropropene	
	10061-01-5	cis-1,3-dichloropropene	
(38V)	100-41-4	ethylbenzene	
(44V)	75-09-2	methylene chloride	
(45V)	74-87-3	chloromethane	
(46V)	74-83-9	bromomethane	
(47V)	75-25-2	bromoform	
(48V)	75-27-4	bromodichloromethane	
(49V)	75-69-4	trichlorofluoromethane	
(50V)	75-71-8	dichlorodifluoromethane	
(51V)	124-48-1	chlorodibromomethane	
(83V)	127-18-4	tetrachloroethene	
(86V)	108-88-3	toluene	
(87V)	79-01-6	trichloroethene	
(88V)	75-01-4	vinyl chloride	

TABLE 2

ORGANICS ANALYSIS DATA SHEET

Sample Number

Laboratory Name: _____ Case No: _____

Sample I.D. No: _____ QC Report No: _____

Multiply Detection Limits by 1 ☐ or 10 ☐ (Check Box for Appropriate Factor)

PESTICIDES

PP #	CAS #		ug/l or ug/kg (circle one)
(89P)	309-00-2	aldrin	
(90P)	60-57-1	dieldrin	
(91P)	57-74-9	chlordane	
(92P)	50-29-3	4,4'-DDT	
(93P)	72-55-9	4,4'-DDE	
(94P)	72-54-8	4,4'-DDD	
(95P)	115-29-7	Endosulfan	
(96P)	115-29-7	Endosulfan	
(97P)	1031-07-8	endosulfan sulfate	
(98P)	72-20-8	endrin	
(99P)	7421-93-4	endrin aldehyde	
(100P)	76-44-8	heptachlor	
(101P)	1024-57-3	heptachlor epoxide	
(102P)	319-84-6	Alpha-BHC	

PESTICIDES

PP #	CAS #		ug/l or ug/kg (circle one)
(103P)	319-85-7	Beta-BHC	
(104P)	319-86-8	Delta-BHC	
(105P)	58-89-9	Gamma-BHC (Lindane)	
(106P)	53469-21-9	PCB-1242	
(107P)	11097-69-1	PCB-1254	
(108P)	11104-28-2	PCB-1221	
(109P)	11141-16-5	PCB-1232	
(110P)	12672-29-6	PCB-1248	
(111P)	11096-82-5	PCB-1260	
(112P)	12674-11-2	PCB-1016	
(113P)	8001-35-2	toxaphene	

DIOXINS

(129P)	1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	

Non-Priority Pollutant Hazardous Substances List Compounds

ACID COMPOUNDS

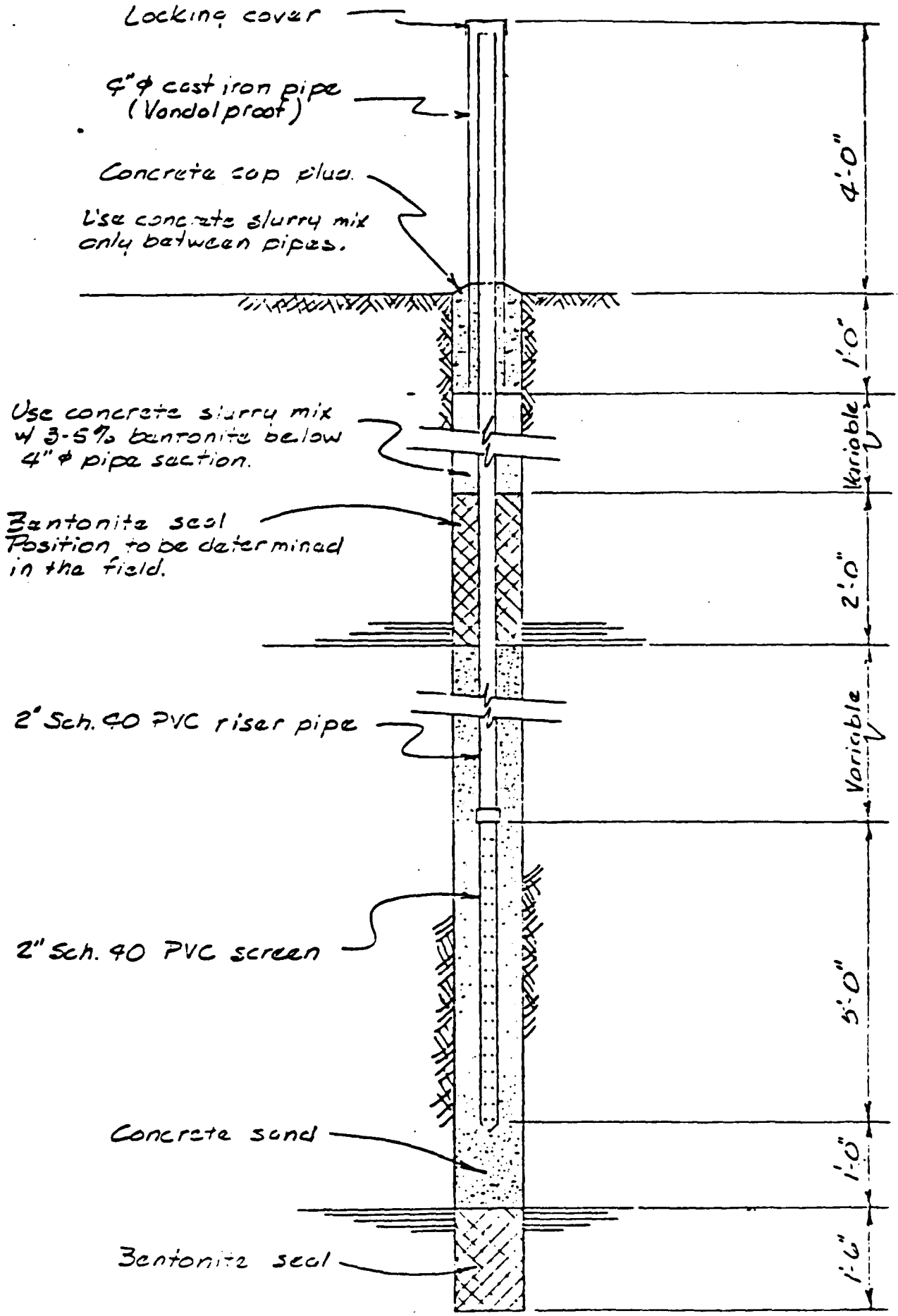
CAS #		ug/l or ug/kg (circle one)
[illegible]	[illegible]	
95-48-7	2-methylphenol	
108-39-4	4-methylphenol	
95-95-4	2,4,5-trichlorophenol	

BASE/NEUTRAL COMPOUNDS

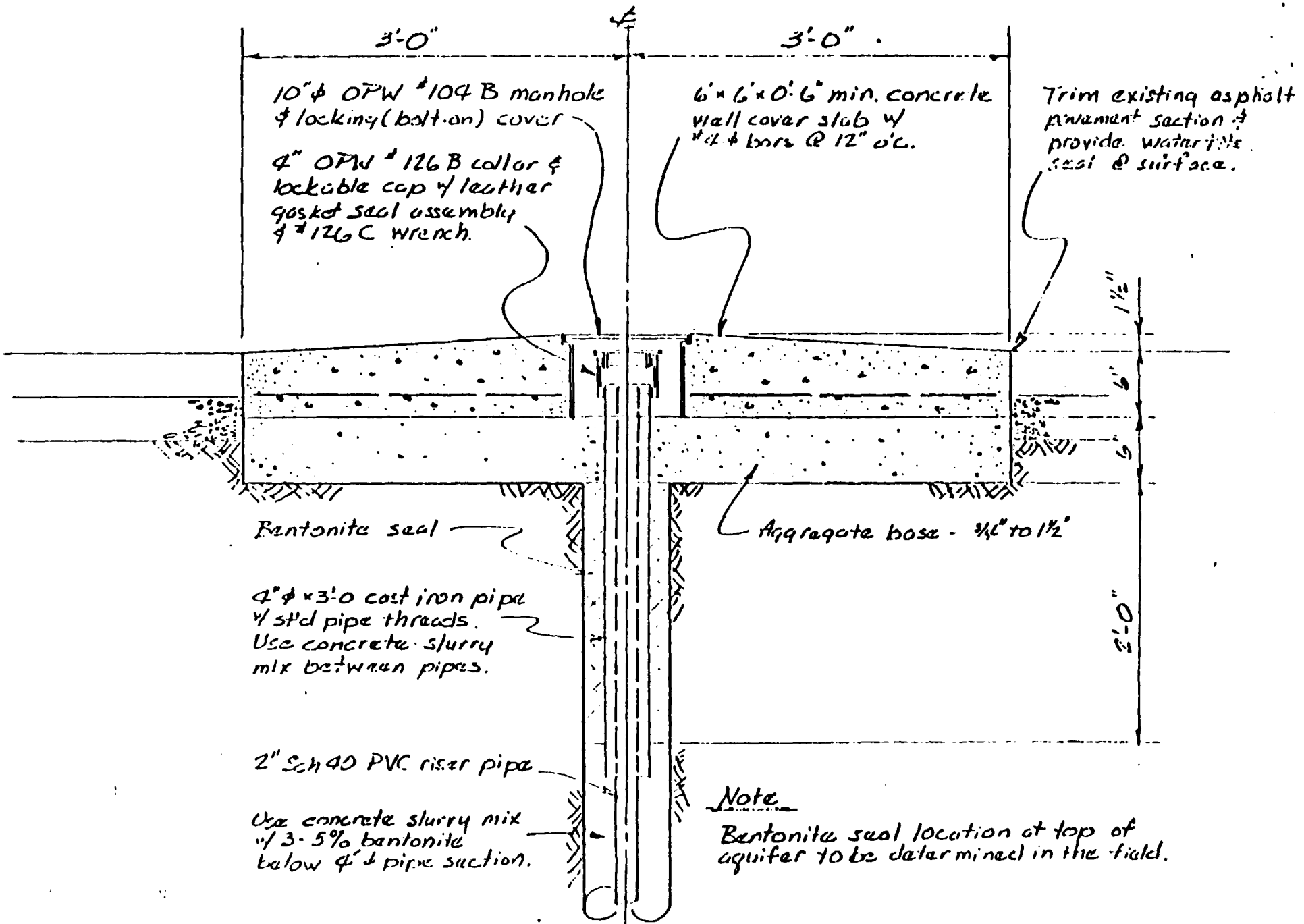
62-53-3	aniline	
100-51-6	benzyl alcohol	
106-47-8	4-chloroaniline	
132-64-9	dibenzofuran	
91-57-6	2-methylnaphthalene	
88-74-4	2-nitroaniline	
99-09-2	3-nitroaniline	
[illegible]	[illegible]	

VOLATILES

CAS #		ug/l or ug/kg (circle one)
[illegible]	acetone	
78-93-3	2-butanone	
75-15-0	carbon disulfide	
519-78-6	2-hexanone	
108-10-1	4-methyl-2-pentanone	
100-42-5	styrene	
[illegible]	vinyl acetate	
95-47-6	o-xylene	



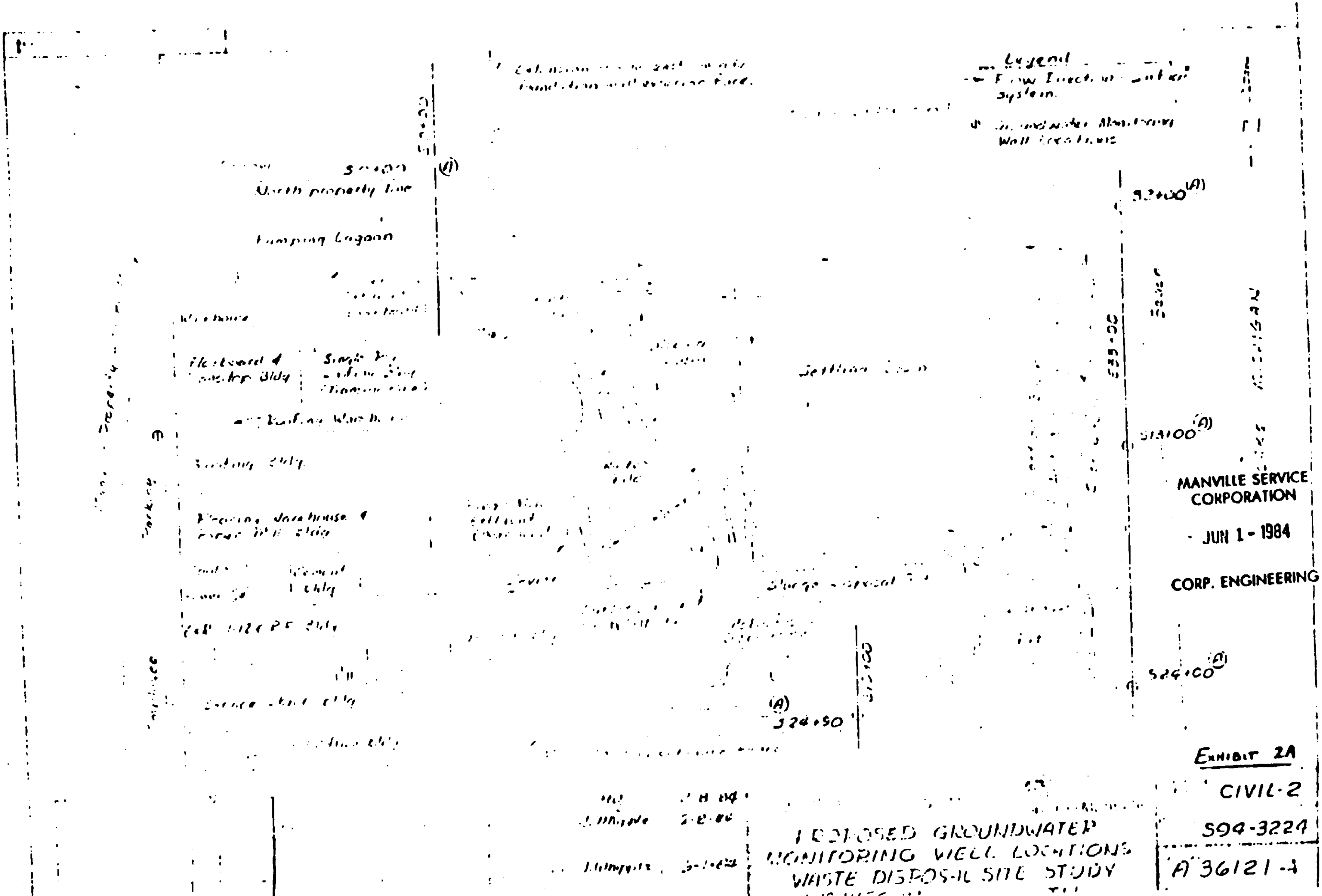
PROPOSED GROUNDWATER MONITORING WELL



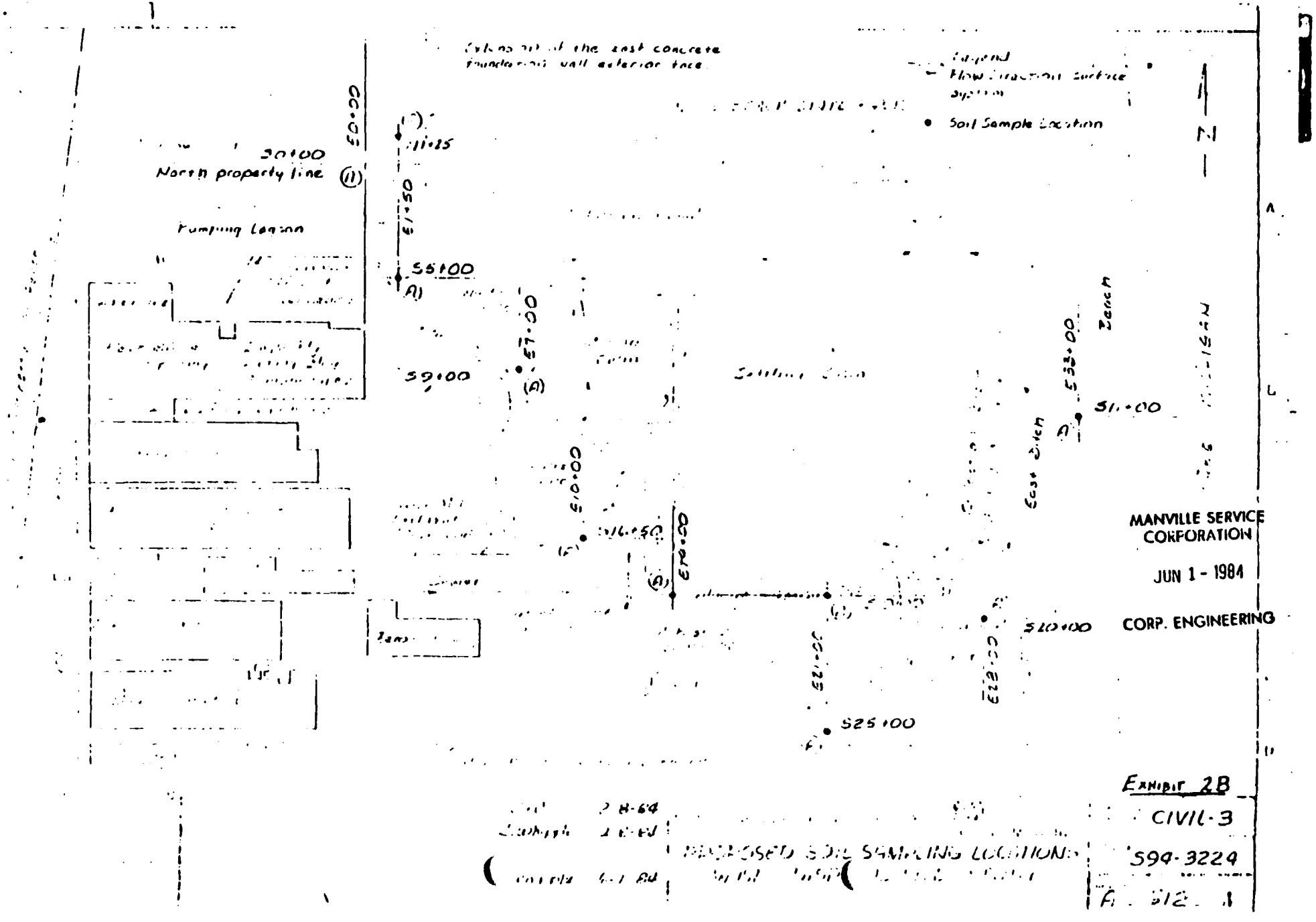
PROPOSED GROUNDWATER MONITORING WELL

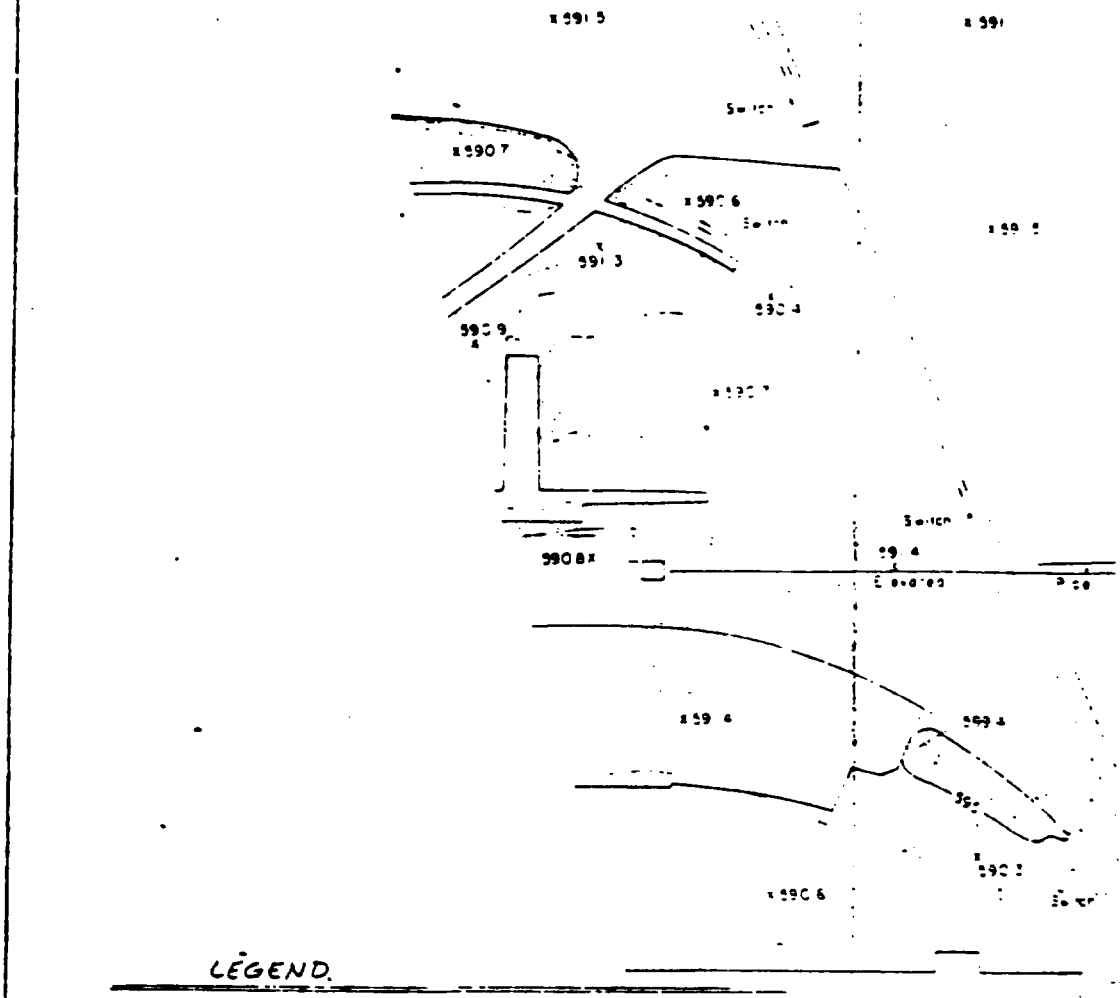
Typical Soil Gas Sampling Points

HW/23Mar84



Legend
Groundwater Monitoring Well Locations
North property line
Pumping Lagoon
Settling Basin
Sludge Disposal
S32+00 (A)
S31+00 (A)
S24+00 (A)
S24+50 (A)
MANVILLE SERVICE CORPORATION
JUN 1 - 1984
CORP. ENGINEERING
EXHIBIT 2A
CIVIL-2
594-3224
PROPOSED GROUNDWATER MONITORING WELL LOCATIONS WASTE DISPOSAL SITE STUDY
A 36121-A


Legend
Soil Sample Location
30+00
North property line
Pumping Station
55+00
59+00
510+00
525+00
MANVILLE SERVICE CORPORATION
JUN 1 - 1984
CORP. ENGINEERING
EXHIBIT 2B
CIVIL-3
594-3224



LEGEND.

Ground water monitoring well locations.
Soil boring locations.

MAP SCALE

0 50 100 200 300 feet

0 50 100 meters

CONTOUR INTERVAL 1FT

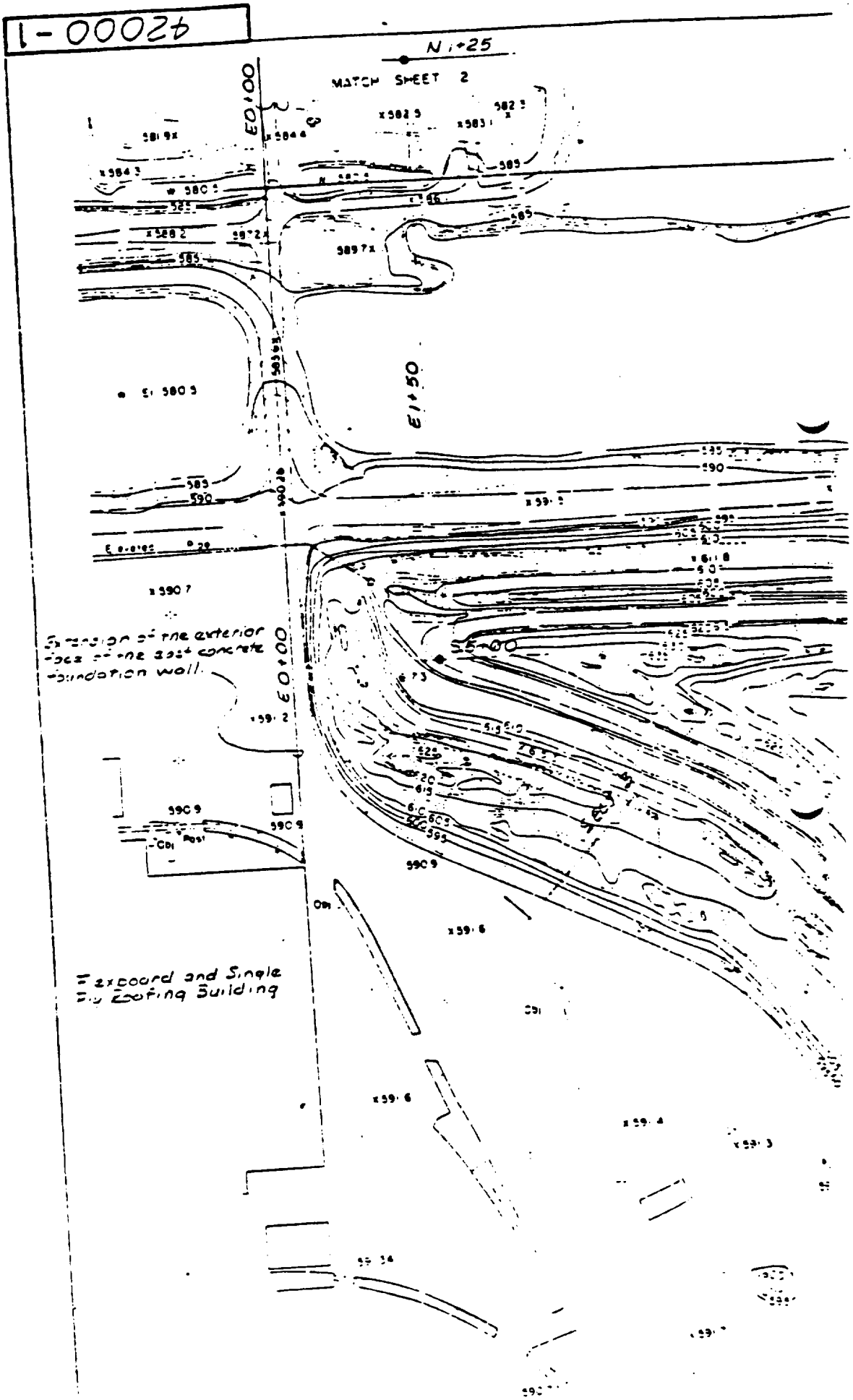
DATE OF PHOTOGRAPHY 11-17-82

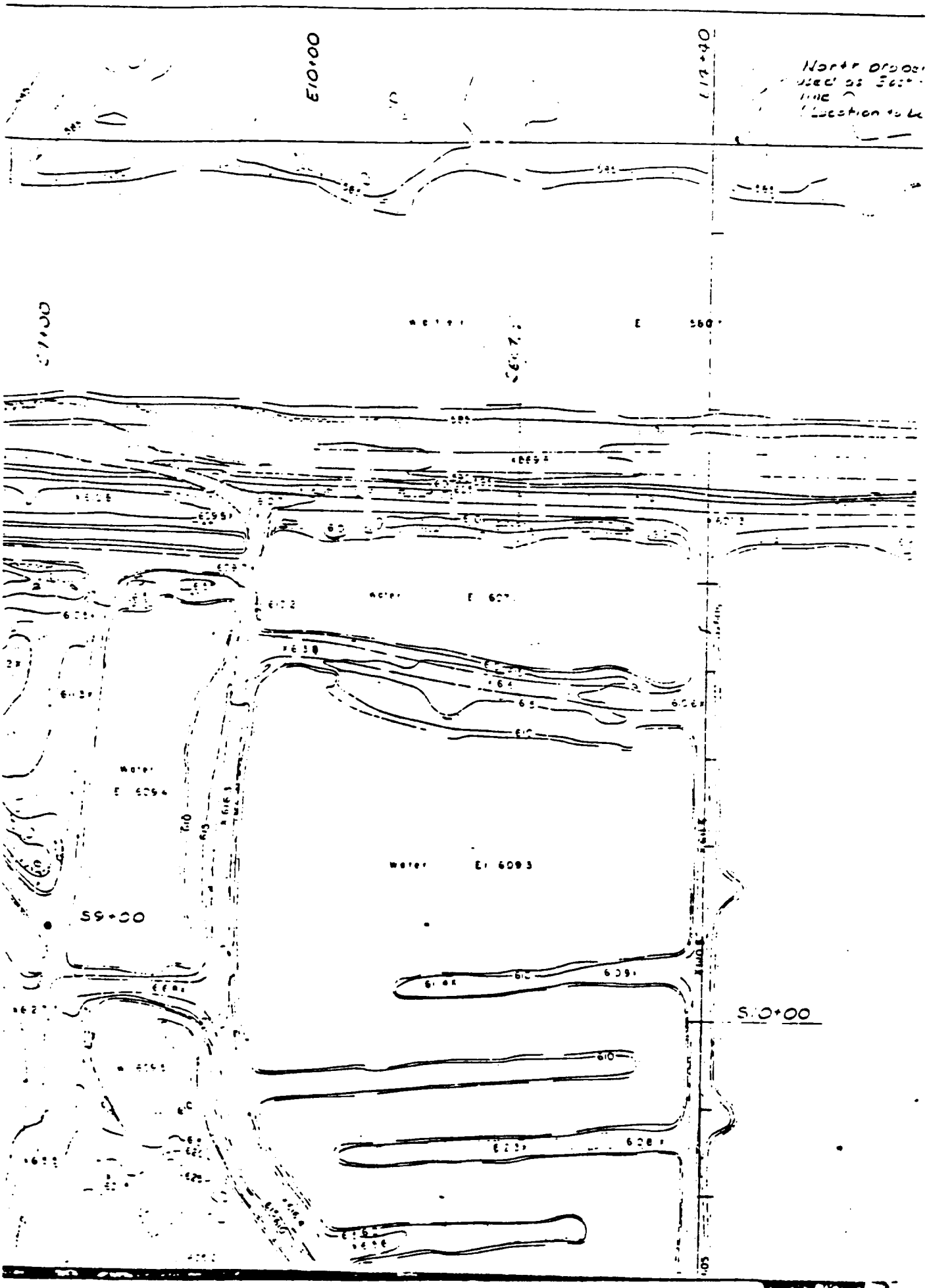
BIOWELL COMPANY JOB NO 82-030

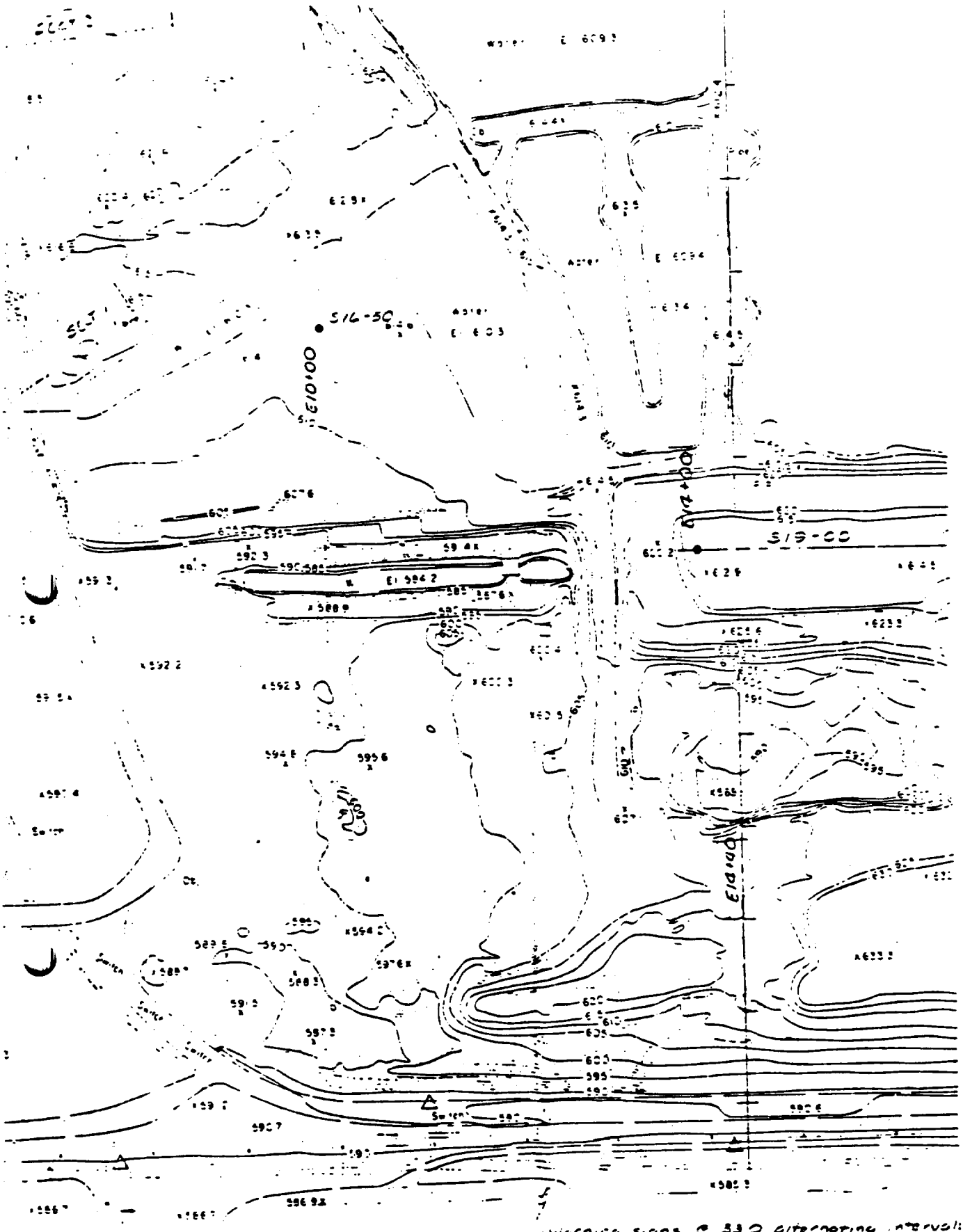
THE BIOWELL COMPANY

SHEET 1

1-00026


N 1+25
MATCH SHEET 2
E0+00
E1+50
E0+00
Extension of the exterior face of the east concrete foundation wall.
Extension of the exterior face of the east concrete foundation wall.
Existing Building
Existing Building


E10+00
11+40
Water
E 609.3
S5+00
S.0+00



-Warning signs @ 330 alternating intervals
(mounted on property fence &
creek mounted @ toe of fill slope.
. work by others.)

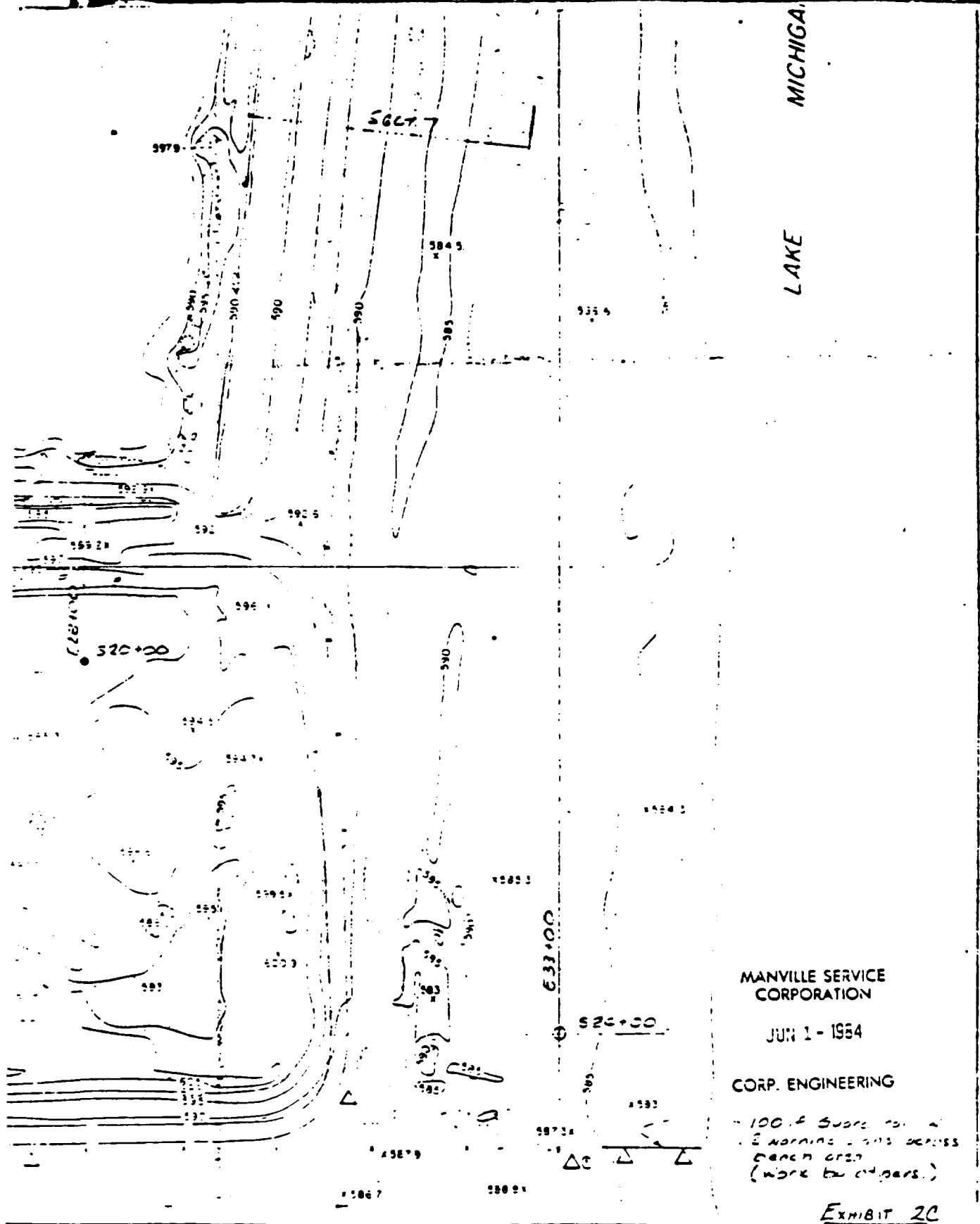
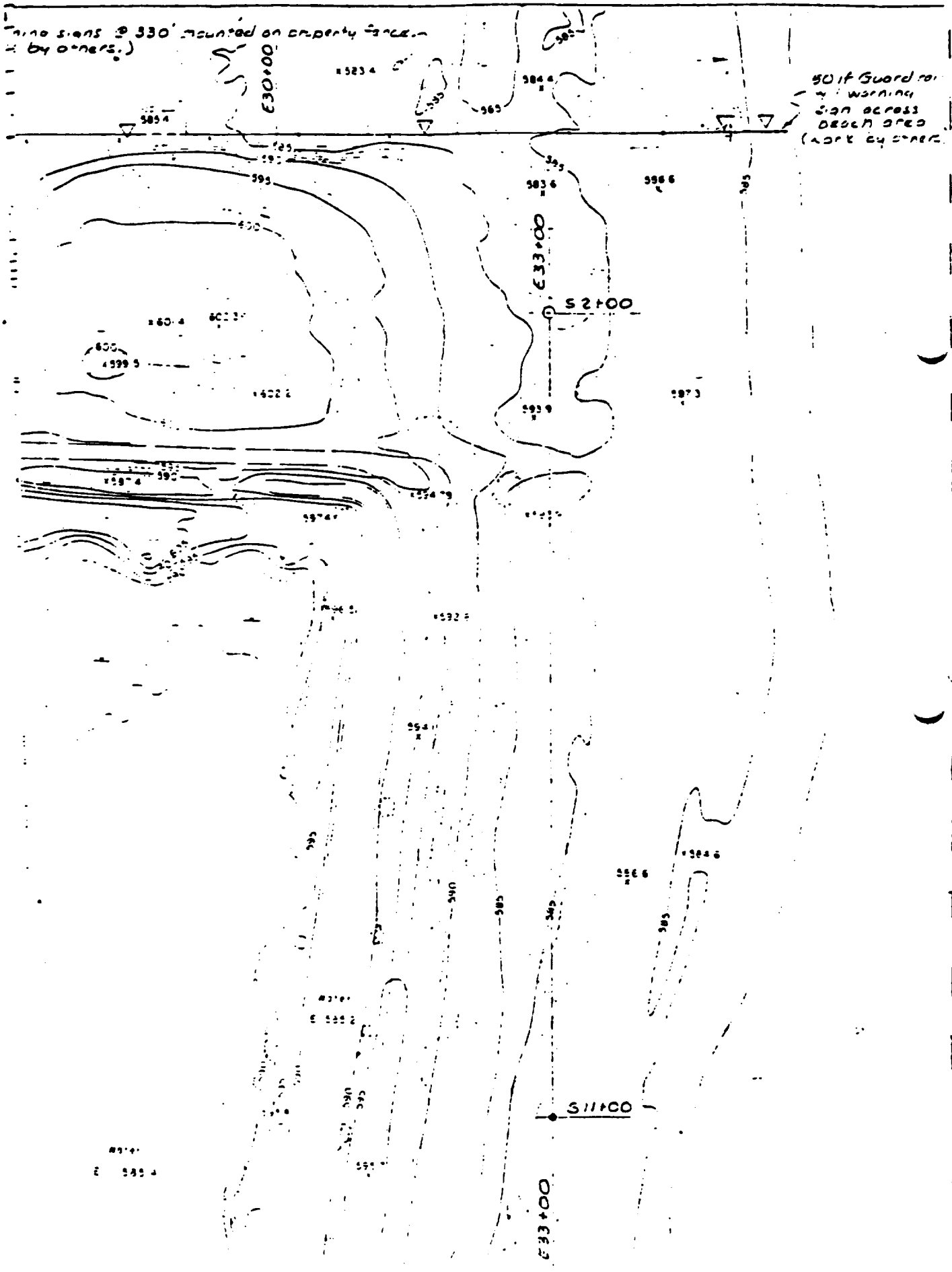
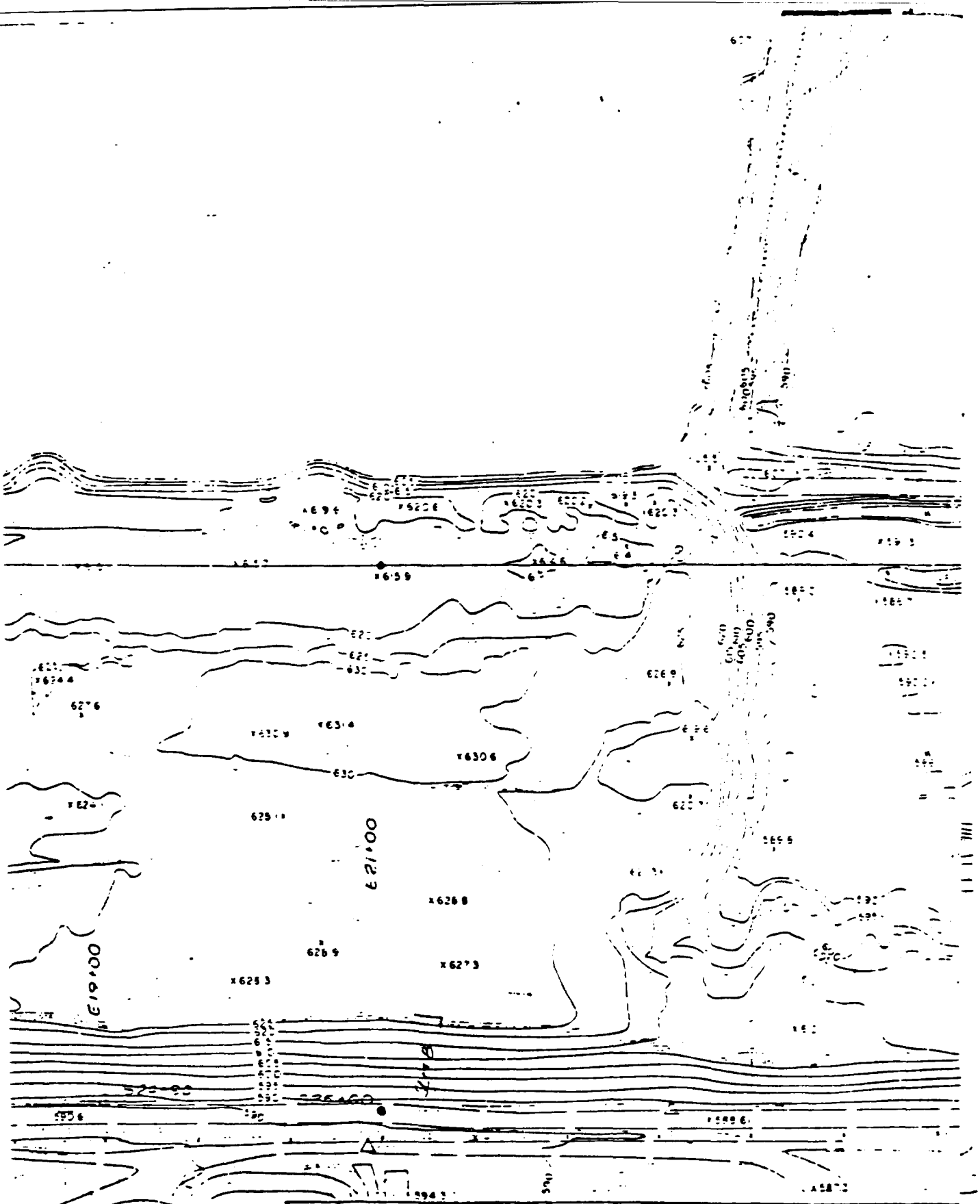


EXHIBIT 2C

SCALE 1"=100'		DATE	Manville — Manville Service Corporation, Corporate Engineering
DRN/DMN			DATE APRIL 17, 1984
CHK BY			TOPOGRAPHIC MAP
APPR BY			PROJ. NO. 59C-3224
PROJ. ENG.			WASTE DISPOSAL SITE
REVISION			GEOTECHNICAL & HDYROLOGICAL STUDY
			WAUKEGAN ILL.
			DWG. NO. A 42000-1 REV


E30+00
E33+00
S2+00
S11+00
E33+00
50 lf Guard rail w/ warning sign across beach area (work by others)



LTR	REVISION	DATE	BY	CHK	OTHER PROJ NO
D	Added [illegible] well no!	5-31-84	[illegible]		
	[illegible]				
C	Added [illegible] sign locations				

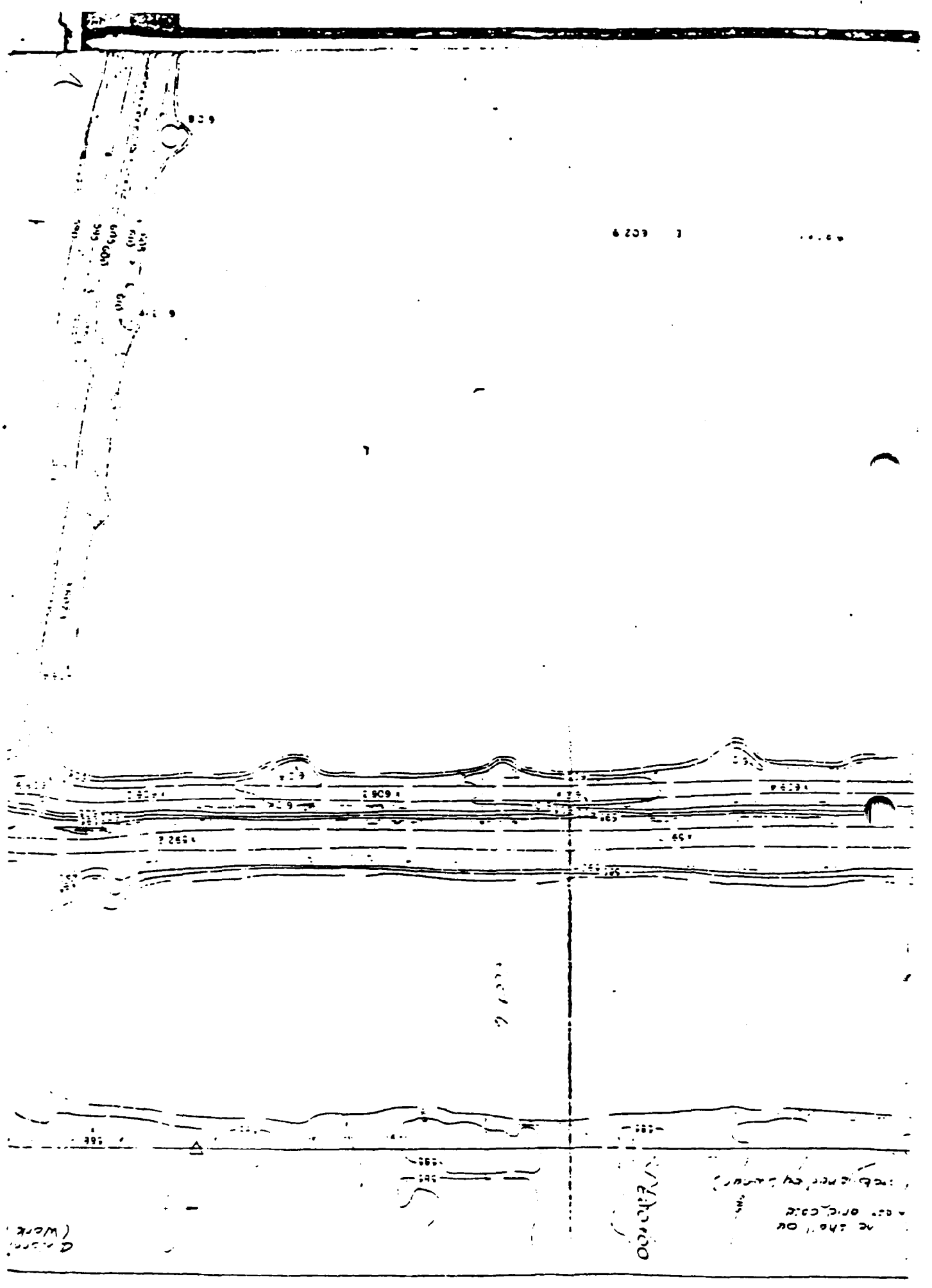


EXHIBIT 3

A. Remedial Investigation Report

The objectives of the RI report will be to document the procedures and results of the detailed site characterization studies. The RI report will include a discussion of the following:

a. Description of air/soil/sediment sampling procedure;

b. Summary of air/soil/sediment laboratory test results;

c. Copies of air/soil/sediment laboratory data sheets;

d. Description of drilling and installation of wells;

e. Summary of well field test results, including a potentiometric map;

f. Copies of boring logs;

g. Description of groundwater sampling procedure;

h. Summary of groundwater test results;

i. Copies of groundwater laboratory data sheets; and

j. An endangerment assessment, including the following:

(1) Objectives

The assessment has two objectives: (1) to provide an evaluation of the level of endangerment to human health and the environment posed by potential or actual release of hazardous substances from the Disposal Area and (2) to provide a basis to differentiate among alternatives in selecting recommended remedial measures. The assessment will involve three steps: identifying

contaminants (amount and form), exposure pathways, environmental fate and transport mechanisms, and receptors; researching hazard information on the contaminants of interest; and evaluating the overall risk to the environment and public health and welfare.

(2) Identify Contaminants, Pathways, and Receptors

Data collected during the field investigations shall be reviewed to identify contaminants which appear to be present in significant concentrations. The amount and form of these contaminants shall be quantified to the extent possible. Possible pathways for contaminant migration shall also be identified. Factors to be considered in evaluating the direction and extent of potential contaminant migration shall include soil permeability, depth to the saturated zone, hydraulic gradients, waste characteristics, meteorological factors, the effects of natural or man-made barriers, the experiences and approaches used in similar situations by State and Federal agencies and private parties, and environmental effects and welfare concerns. Receptors which may be impacted by the contaminants shall be identified. Receptors may include significant habitats, as well as people near the site who breathe the air or use groundwater as a potable water source. The human population at risk (i.e., those having present or potential contact with contaminants from the site) shall be identified.

(3) Research Hazard Information

A literature review shall be conducted on the hazardous properties of the contaminants of greatest interest, identified in Subtask 2) above. If available, toxicity profiles, published criteria, and other data on the specific compounds or families of compounds shall be collected and synthesized. Criteria for contaminants may include National Interim Primary and Secondary Drinking Water Standards, NIOSH reports, Ambient Water Quality Criteria developed by EPA, and existing and published proposed criteria for asbestos in the workplace and the environment.

(4) Evaluate Overall Risks

Using information developed in Subtasks 2) and 3), the potential impacts of potential or actual release of hazardous substances from the Disposal Area on human health and the environment shall be evaluated. To the extent possible, expected contaminant distributions on land, in air, and in groundwater and surface water shall be described. If available data are not sufficient to complete a detailed quantitative evaluation, predictions of contaminant distributions may be qualitative, sufficient to provide a general evaluation of the risks posed by the site. The assessment shall describe the number of receptors affected, levels of contaminant exposure, and associated public health risks and environmental impact.

k. Discussion of project objectives for evaluation in the FS.

B. Alternative Remedial Actions Evaluation

The objectives of the alternative remedial actions evaluation task will be to evaluate alternative remedial actions on the basis of economic, environmental, and engineering criteria and to select an alternative or combination of alternatives for conceptual design and implementation. The level of detail to be used in these evaluations will identify only comparative or relative differences among alternatives. A schedule for conducting this evaluation shall be submitted to U.S. EPA for approval within 14 days of approval of the RI report.

B-1: Description of Proposed Response. The objective of this section will be to summarize the site background information and the nature and extent of the problem. In consultation with USEPA the site-specific objectives, screening criteria, and proposed response would be developed. Screening criteria shall include the following:

- Economic--both capital and operating costs will be considered;
- Environmental Effects--any adverse impacts on health and welfare or the surrounding environment which might be associated with an alternative will be considered;
- Engineering--each alternative must be technically feasible, applicable to project needs, and must be a reliable method of solving the problem.

B-2: Development of Alternatives. The objective of this section will be to compile a list of potential source control and off-site remedial action alternatives. The alternatives would be based on site-specific objectives and public health and welfare and environmental concerns. This list shall be submitted to U.S. EPA prior to initial screening of the alternatives.

B-3: Initial Screening of Alternatives. The objective of this section will be to evaluate alternative remedial actions based on cost, effects of alternative, and acceptable engineering practices. Alternatives that far exceed the costs of other alternatives evaluated and do not provide substantially greater public health or environmental benefit would be excluded from further consideration. Only those alternatives that effectively contribute to the protection of public health, welfare, or the environment would be considered further. Alternatives must

also be considered feasible, be applicable to the problem, and represent a reliable means of addressing the problem. A list of alternatives for more detailed evaluation shall be developed and submitted to U.S. EPA for approval.

B-4: Detailed Analysis of Alternatives. The objective of this section will be to develop engineering details on the remaining alternatives and Order-of-Magnitude cost estimates. These engineering details would include alternative descriptions and conceptual site layout drawings, operation and maintenance requirements, a preliminary implementation schedule, safety requirements, and special engineering considerations. Another objective would be to assess each alternative in terms of the extent to which it is expected to effectively mitigate and minimize damage to, and provide adequate protection of, public health, welfare, and the environment, relative to the other alternatives analyzed. A determination will be made as to whether the existing data are adequate to fully evaluate each of the options. If the data are found to be inadequate, additional studies of the site may be necessary.

Rankings of the remedial action options shall be formulated for each of the economic, environmental, and engineering assessment categories. The economic assessment shall compare remedial action alternatives according to:

- Order-of-magnitude construction and operation and maintenance costs;
- Detailed cost estimation, including distribution of costs over time and present worth analysis.

The environmental assessment shall compare alternatives according to:

- The known adverse environmental effects of the alternatives;
- The effectiveness of measures designed to mitigate adverse effects, and costs of mitigation;
- The adequacy of source control measures;
- The effectiveness of offsite control measures, if needed;
- The permitting and other legal and institutional requirements.

The engineering assessment shall compare alternatives according to the following factors, with emphasis on the use of established technology:

- Reliability;
- Health and safety risks of construction and operation;
- Feasibility of construction and operation;
- Offsite transportation and disposal requirements, if appropriate to the remaining alternatives;
- Compliance with applicable regulations.

An overall ranking will be prepared to determine the most cost-effective alternative for the site. (i.e. the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare, and the environment.)

C. Feasibility Study Report

The objective of the FS report will be to compile and describe methods, results, and conclusions of the alternative remedial actions evaluation task. The report would incorporate and include the following:

a. Summary of the hazards and potential hazards for which corrective action is required;

b. Detailed analysis of alternative technologies which can be employed to effectuate the corrective action, such analyses to include those items outlined in 40 C.F.R. 300.68(i)(2)(A) through (E) of the National Contingency Plan;

c. Description of all studies performed or evaluated to confirm the applicability of each alternative assessed;

d. Unit cost estimates for each alternative;

e. Operation and maintenance requirements with cost estimates, for each alternative;

f. Long-term integrity for each alternative;

g. Timeliness of implementation for each alternative; and

h. A discussion of conformity to federal, state, and local laws and regulations, for each alternative.

APPENDIX J

TECHNICAL MEMORANDUM No. M-1

"Asbestos Analysis of Water Samples By Electron Microscopy"

TECHNICAL MEMORANDUM # M-1

ASBESTOS ANALYSIS OF WATER SAMPLES

BY

ELECTRON MICROSCOPY

JOHNS-MANVILLE DISPOSAL AREA

WAUKEGAN, ILLINOIS

JUNE, 1985

KUMAR MALHOTRA & ASSOCIATES, INC.
ENGINEERS • CONSULTANTS • PLANNERS
Grand Rapids, Michigan/Monroe, Wisconsin

Technical Memorandum # M-1

ASBESTOS ANALYSIS OF WATER SAMPLES BY ELECTRON MICROSCOPY

Johns-Manville Disposal Area, Waukegan, Illinois

Two sets of ground water samples were collected in September, 1984 in accordance with the approved work plan for site hydrological and geotechnical investigations. One set was analyzed by Canton Laboratory, Ypsilanti, Michigan by phase-contrast microscopy. The results obtained are presented in Table 4-7 (p. 4-25) in the "Draft Remedial Investigation Report", Volume 1, March, 1985. These results indicated that the asbestos fiber concentration was below the detection limit of the analytical technique,which is less than 50,000 fibers/liter. Since it is quite common to find asbestos fibers in beverages and water in the order of several million fibers per liter (see Appendix M-1-B, "Report of the Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario" Volume II Chapter 11 - Asbestos in the Environment) it was decided to get the second set of samples analyzed for asbestos fibers by electron microscopy. As indicated in the Draft RI Report, these samples were sent to EMS Laboratories, Hawthorne, Calfornia. These were analyzed by using transmission electron microscopy technique "Interim method for determining asbestos in water", EPA-600/4-80-005. The results were obtained in the last week of March, 1985 and are presented in Appendix M-1-C. Asbestos fiber concentration of Well #3 sample was substantially less than that of Wells # 2 & 4 samples although it is located in between Wells # 2 & 4 and is in the general direction of ground water movement. These results also indicated that upgradient ground water (Well # 5) sample had higher asbestos fiber concentration than those of the downgradient ground water (Wells # 2, 3 & 4) samples. Because of these gross inconsistencies in the results a second round of ground water sampling was conducted on April 29 and April 30, 1985. Representatives of USEPA, were advised accordingly.

Each well was pumped for about 90 minutes at a rate of 13 to 18 gpm prior to sample collection. In addition, surface water samples from Lake Michigan were collected to provide comparative data with the ground water sampling data. The following surface water sampling locations were chosen for this purpose (See Figure M-1-1).

- Lake Michigan shore, east of monitoring well #4
- Lake Michigan shore, east of monitoring well # 2
- Lake Michigan Shore, north of Commonwealth Edison cooling water discharge point
- Lake Michigan, Waukegan City water intake

All water samples were shipped to EMS Laboratories, Hawthorne, California for asbestos fiber count by electron microscopy. The results are presented in Table M-1-1 and Appendix M-1-A.

APPENDIX M-1-A

ASBESTOS RESULTS OF GROUNDWATER AND
LAKE MICHIGAN WATER SAMPLES
COLLECTION IN APRIL, 1985
(Second Round of Sampling)

ASBESTOS ANALYSIS OF WATER SAMPLES BY ELECTRON MICROSCOPY

Johns-Manville Disposal Area, Waukegan, Illinois

Discussion of Results:

The second round of ground water sampling results show good consistency and are in the same range as the lake water sample results. The observed range of 6 to 12 million fibers/l in the ground water samples and 5.5 to 19 million fibers/l for the lake water samples are essentially the same, considering the inherent variability in the analytical procedure for counting asbestos fibers. Further, these observed asbestos levels in the lake and ground water samples are no different from those reported in the literature (Table 11.1 Appendix M-1-B - 11.7 million fibers/l in Italian Vermouth, 12.2 million fibers/l in Gingerale, and 9.5 million fibers/l in tap water in Hull, Quebec).

Based on the observed lake and ground water sampling results it is apparent that the Johns-Manville Waste Disposal Area at Waukegan, Illinois is not impacting the ground water and Lake Michigan water quality in the vicinity of the site.

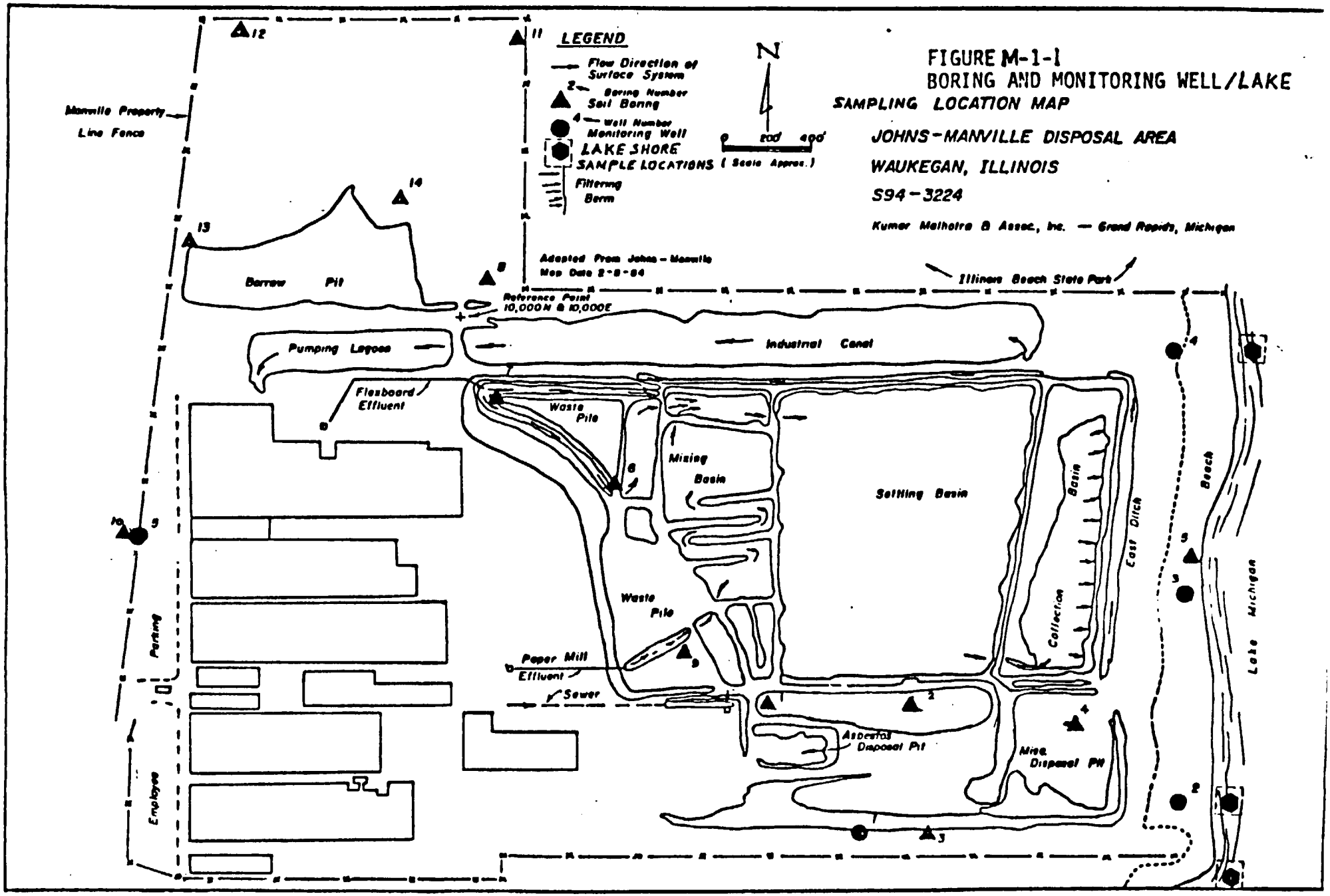

LEGEND
Flow Direction of Surface System
Boring Number
Soil Boring
Well Number
Monitoring Well
LAKE SHORE SAMPLE LOCATIONS
Filtering Berm
N
0 200 400'
(Scale Approx.)
FIGURE M-1-1
BORING AND MONITORING WELL/LAKE SAMPLING LOCATION MAP
JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
S94-3224
Kumar Malhotra & Assoc., Inc. — Grand Rapids, Michigan
Adapted From Johns-Manville Map Date 2-8-84
Manville Property Line Fence
Illinois Beach State Park
Reference Point 10,000N & 10,000E
Barrow Pit
Pumping Lagoon
Industrial Canal
Flexboard Effluent
Waste Pile
Mixing Basin
Settling Basin
East Ditch Collection Basin
Beach
Lake Michigan
Waste Pile
Paper Mill Effluent
Sewer
Asbestos Disposal Pit
Misc. Disposal Pit
Barrow Pit
Employee Parking

TABLE M-1-1

SUMMARY OF ASBESTOS RESULTS
(CHRYSOTILE FIBERS BY TEM)

Sampling Dates: April 29 and 30, 1985

Sample Description	Fibers Concentration*
M.W #1	6
M.W #2	9
M.W #3	12
M.W #4	7.8
M.W #4 (Replicate)	10.8
M.W #5	7.5
Field Blank	0.2
Lake Michigan Shore (East of Well #4)	13
Lake Michigan Shore (East of Well #2)	11
Lake Michigan Shore, (North of Commonwealth Edison Cooling Water Discharge)	19
Lake Michigan, Waukegan City Water Intake	5.5

* In million fibers per liter

Client Kumar Malhotra + Assoc. Inc.

Sample Description Blank EMS Lab No. 6242

Chrysotile Fibers	0.01	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	2×10^{-5}	µg/L
More/Less than 5 Chrysotile Fibers in Sample	Less	
Detection Limit	0.01	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	1	0	0	0	0	0

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	0	1	0	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	1	0	0	0	0	0

EMS Labs

Client Kumar Malhotra + Assoc. Inc.

Sample Description Well #1 EMS Lab No. 6242

Chrysotile Fibers	6	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	0.05	µg/L
More/Less than 5 Chrysotile Fibers in Sample	Exactly Five	
Detection Limit	1.2	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	1	2	1	1	0	0

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	0	4	1	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	1	3	1	0	0	0

EMS Laboratories

Client Kumar Malhotra + Assoc. Inc.

Sample Description Well #2 EMS Lab No. 6242

Chrysotile Fibers	9	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	0.02	µg/L
More/Less than 5 Chrysotile Fibers in Sample	Less	
Detection Limit	3	MFL

-J-8-

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	2	1	0	0	0	0

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	1	2	0	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	2	0	0	1	0	0

EMS Laboratories

Client Kumar Malhotra + Assoc. Inc.

Sample Description Well #3 EMS Lab No. 6242

Chrysotile Fibers	12	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	0.1	µg/L
More/Less than 5 Chrysotile Fibers in Sample	More	
Detection Limit	1.5	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	2	2	1	2	0	1

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	0	8	0	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	2	2	1	2	1	0

EMS Laboratories

Client Kumar & Associates / Kumar & Associates, Inc.

Sample Descript. Well #4

EMS Lab No. 6242

Chrysotile Fibers	7.8	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	0.05	µg/L
More/Less than 5 Chrysotile Fibers in Sample	More	
Detection Limit	0.6	MFL

J-10

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	4	5	1	1	1	1

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	2	11	0	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	4	3	4	1	0	1

Client Kumar Malhotra + Assoc. Inc.

Sample Description Well #4-A

EMS Lab No. 6242

Chrysotile Fibers	10.8	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	0.08	µg/L
More/Less than 5 Chrysotile Fibers in Sample	More	
Detection Limit	0.6	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	3	8	3	2	2	0

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	1	15	2	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	6	7	2	1	2	0

Client Kumar Malhotra + Assoc. Inc.

Sample Description Well # 5 EMS Lab No. 6242

Chrysotile Fibers	7.5	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	0.02	µg/L
More/Less than 5 Chrysotile Fibers in Sample	Exactly Five	
Detection Limit	1.5	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	1	4	0	0	0	0

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	1	4	0	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	1	3	1	0	0	0

EMS Laboratories

Client KUMAR MALHOTRA + ASSOC., INC.

Sample Description EAST OF WELL #4 EMS Lab No. 6242

Chrysotile Fibers	13	MFL
>5 Microns Length (Chrysotile)	1.2	MFL
Mass (Chrysotile)	0.1	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	1.2	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	1	8	1	0	0	1

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	2	5	4	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	4	4	0	2	0	1

EMS Laboratories

Client KUMAR MALHOTRA + ASSOC., INC.

Sample Description EAST OF WELL #2 EMS Lab No. 6242

Chrysotile Fibers	11	MFL
>5 Microns Length (Chrysotile)	0.6	MFL
Mass (Chrysotile)	0.1	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	0.6	MFL

J-14

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	1	9	5	2	0	1

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	3	13	1	1	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	4	7	4	1	0	2

EMS Laboratories

Client KUMAR MALHOTRA + ASSOC., INC.

Sample Description NORTH OF COMMONWEALTH EDISON EMS Lab No. 6242

Chrysotile Fibers	19	MFL
>5 Microns Length (Chrysotile)	BELOW DETECTION LIMIT	MFL
Mass (Chrysotile)	0.2	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	1.2	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	2	7	4	2	1	0

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	1	13	2	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	2	8	3	2	1	0

EMS Laboratories

Client KUMAR MALHOTRA + ASSOC., INC.

Sample Description LAKE WATER INTAKE EMS Lab No. 6242

Chrysotile Fibers	5.5	MFL
>5 Microns Length (Chrysotile)	0.2	MFL
Mass (Chrysotile)	0.04	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	0.2	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	6	9	4	0	1	3

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	0	21	2	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	7	8	4	0	2	2

Client Kumar Malhotra & Assoc. Inc

Sample Description Field Blank EMS Lab No. 6242

Chrysotile Fibers	0.2	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	2×10^{-3}	µg/L
More/Less than 5 Chrysotile Fibers in Sample	More	
Detection Limit	0.03	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	2	1	4	0	0	1

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	0	8	0	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	3	1	3	0	0	1

APPENDIX M-1-B

CHAPTER 11
"ASBESTOS IN THE ENVIRONMENT"

From Volume II of Report of the Royal Commission
on Matters of Health and Safety arising from the use of
Asbestos in Ontario, Canada

B. Asbestos in Water, Food, Beverages, and Drugs

B.1 Introduction

In Chapter 5 we discuss the evidence regarding health effects of eating or drinking asbestos fibres. There we conclude that the evidence fails to indicate any increased risk of alimentary tract tumours following the direct ingestion of asbestos fibres. This conclusion is based on two sources of evidence. First, most animal evidence shows that feeding asbestos to animals does not cause an increase in gastrointestinal cancer, and in fact does not cause asbestos fibres to be lodged in the gastrointestinal tract. If the fibres are not retained in the gastrointestinal tract, as they are in the lungs, it is highly unlikely that they will cause disease. Second, epidemiological studies of human health related to asbestos levels in drinking water have generally found no health effects from high asbestos levels. In a Canadian study, Toft et al. analyzed water-borne asbestos levels and mortality rates in 71 municipalities across Canada.[25] The researchers concluded that there was not a significant relationship between water-borne asbestos levels and gastrointestinal cancer. A study by Conforti et al. was the only one of more than a half-dozen studies of health and asbestos in drinking water that suggested any such relationship, and even there the sug-

[25] P. Toft et al., "Asbestos and Drinking Water in Canada," *The Science of the Total Environment* 18 (1981): 77–89.

gested relationship was weak.[26] Only a fraction of the many analyses performed by Conforti et al. pointed to a correlation of asbestos with cancer, and the authors noted that confounding factors such as smoking, occupation, and alcohol consumption may be important but were not allowed for in the study.

In summary, we find that oral ingestion of asbestos in concentrations currently found in water, food, or beverages in North America is not associated with any significant increase in disease. Although negative epidemiological studies cannot conclusively prove that there is no association, the populations studied have been sufficiently large that all but the smallest health effects would have been detected. For their part, the bulk of the animal studies have shown no association between oral asbestos ingestion and gastrointestinal cancer.

We, therefore, find that there is no reason for public concern about the health effects of asbestos in water, food, and beverages. However, as the presence of asbestos in water, food, and beverages has been extensively studied, we summarize the data below.

B.2 Asbestos in Drinking Water

The measurement of asbestos fibre concentrations in water may be performed using transmission electron microscopy (TEM). The water sample is drawn through a Nuclepore filter, which is then carbon-coated. The filter is dissolved, leaving the thin carbon-coating with embedded fibres ready for examination using a TEM. The U.S. EPA has commissioned a study, to be published by early 1984, which develops a standardized method of measurement for asbestos fibres in water. The fibre concentration is usually reported in millions of fibres of all sizes per litre of water; there is usually no separate count of fibres longer than 5 microns. A comparison of these fibre concentrations with airborne fibre concentrations would be meaningless because serious disease may arise from exposure to airborne fibres, while there is no reason for concern about the health effects of asbestos in water.

Asbestos in H_2O vs airborne

Cunningham and Pontefract's Canadian study detected levels of asbestos in tap water, melted snow, and river water ranging from 2 million to 173 million fibres per litre.[27] These results are shown in Table 11.1. Unfiltered tap water in a Quebec asbestos mining town contained the highest

[26] Paul M. Conforti et al., "Asbestos in Drinking Water and Cancer in the San Francisco Bay Area: 1969–1974 Incidence," *Journal of Chronic Diseases* 34 (1981): 211–224.

[27] Hugh M. Cunningham and Roderic D. Pontefract, "Asbestos Fibres in Beverages and Drinking Water," *Nature (London)* 232 (30 July 1971): 332.

levels. River water contained more asbestos fibres than water drawn from a city filtration system and melted snow contained higher amounts than river water. Most fibres detected were below 1 micron in length.

Kay reported on asbestos fibre levels in drinking water from 21 cities in Ontario, drawing on surface waters for samples.[28] Samples were examined at a magnification which ranged from 25,000 to 50,000 times. As with Cunningham and Pontefract's investigation, the detected fibre levels varied widely. For instance, Kay found Ottawa's tap water to have a fibre count of 0.136 million fibres per litre, while Sarnia's count was 3.87 million fibres per litre. Kay's data are summarized in Table 11.2. Additional surveys undertaken in Metropolitan Toronto found levels of asbestos which ranged from 0.724 million to 4.06 million fibres per litre.

Health and Welfare Canada commissioned a national survey for asbestos fibres in Canadian drinking water in 1977.[29] The authors of the study, which was done under the auspices of the Ontario Research Foundation, relied on the U.S. EPA's preliminary interim method to evaluate the concentration and type of asbestos present in water samples. The study reported on samples from 71 locations across Canada, representing the water supplies of close to 55% of the Canadian population. Samples were obtained from the raw water source, from the water treatment plant, and from the water distribution network. The researchers concluded that amphibole asbestos was not a major contaminant of Canadian drinking water supplies. In locations where amphibole asbestos was detected, there was usually a much higher concentration of chrysotile fibres. The highest concentrations of chrysotile fibres were detected in Baie Verte, Newfoundland, and Disraeli, Quebec, at levels of up to 1,800 million fibres per litre. In Ontario, the highest levels were found in Thunder Bay, Kirkland Lake, and Hearst, with detected values of up to 3 million, 3.5 million, and 22 million fibres per litre respectively. Data from this study are shown in Table 11.3. Potable water in the 15 other locations sampled in Ontario had fibre levels below 1 million fibres per litre.

The difficulties in measuring asbestos fibre concentrations in water may be illustrated by the controversy surrounding asbestos levels in the water in Thunder Bay, Ontario, in 1975. Early in 1975, researchers at Lakehead University reported asbestos concentrations in the drinking water in that city ranging from 0.45 million fibres per litre to 14.7 million fibres

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[28] G.H. Kay, "Asbestos in Drinking Water," *Journal American Water Works Association* 66:9 (September 1974): 513-514.

[29] Eric J. Chatfield and M. Jane Dillon, *A National Survey for Asbestos Fibres in Canadian Drinking Water Supplies*, 79-EHD-34 (Ottawa: Health and Welfare Canada, Environmental Health Directorate, 1979).

Table 11.1

Asbestos Fibre Concentrations in Beverages and Water

Sample	Source	Millions of Fibres per Litre
Beer	Canadian 1	4.3
Beer	Canadian 2	6.6
Beer	U.S.A. 1	2.0
Beer	U.S.A. 2	1.1
Sherry	Canadian	4.1
Sherry	Spanish	2.0
Sherry	South African	2.6
Port	Canadian	2.1
Vermouth	French	1.8
Vermouth	Italian	11.7
Soft drink	Ginger ale	12.2
Soft drink	Tonic water I	1.7
Soft drink	Tonic water II	1.7
Soft drink	Orange	2.5
Tap water	Ottawa, Ottawa River*	2.0
Tap water	Toronto, Lake Ontario*	4.4
Tap water	Montreal, St. Lawrence River*	2.4
Tap water	Hull, Quebec, Ottawa River**	9.5
Tap water	Beauport, Quebec, St. Lawrence River (6 km below Quebec City)**	8.1
Tap water	Drummondville, Eastern Townships, Quebec, St. François River*	2.9
Tap water	Asbestos, Eastern Townships, Quebec, Nicolet River*	5.9
Tap water	Thetford Mines, Eastern Townships, Quebec, Lac à la Truite**	172.7
Melted snow	Ottawa, top 30 cm (2-3 weeks' precipitation)	33.5
River water	Ottawa River, at Ottawa	9.5

Notes: *Filtration plant used.
**No filtration plant used.

SOURCE: Hugh M. Cunningham and Roderic D. Pontefract, "Asbestos Fibres in Beverages and Drinking Water," *Nature (London)* 232 (30 July 1971): 332.

Table 11.2

Asbestos Fibre Concentrations in Ontario Tap Water

Sample Location	Source	Millions of Fibres per Litre	Estimated Mass Concentration, Nanograms per Litre
Toronto	Lake Ontario	1.9	0.941
Belleville	Bay of Quinte	0.533	0.937
Brantford	Grand River	0.570	1.13
Brockville*	St. Lawrence River	0.446	0.602
Chatham	Thames River	0.595	1.57
Cornwall	St. Lawrence River	2.11	0.729
Hamilton	Lake Ontario	0.694	0.154
London	Lake Huron	0.456	0.429
Niagara Falls	Niagara River	2.58	2.25
North Bay*	Trout Lake	0.384	0.104
Oshawa	Lake Ontario	0.557	0.159
Ottawa	Ottawa River	0.136	0.093
Pembroke*	Ottawa River	2.85	0.538
Peterborough	Otonabee River	1.86	3.54
Port Colborne	Welland Ship Canal	0.608	0.847
Sarnia*	Lake Huron	3.87	2.13
Sault Ste. Marie*	St. Marys River	0.248	0.141
St. Catharines	Welland Ship Canal	1.03	1.56
Sudbury*	Ramsay Lake	0.297	0.542
St. Thomas	Lake Erie	1.60	0.500
Thunder Bay*	Lake Superior	0.830	0.235
Welland	Welland Ship Canal	0.820	0.479

Note: *No filtration plant used.

SOURCE: Adapted from: G.M. Kay, "Asbestos in Drinking Water," *Journal American Water Works Association* 66:9 (September 1974), Table 1, p. 514.

Table 11.3

Summary of Asbestos Fibre Concentrations in Ontario Tap Water
(Millions of Fibres per Litre)

City	Chrysotile			Amphibole			Water Filtration
	Raw Water Input	Treated Water Output	Distribution Network	Raw Water Input	Treated Water Output	Distribution Network	
Cochrane	•	•	0 - 0.5	•	•	0 - 0.5	Yes
Hamilton	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	Yes
Hearst	•	•	11 - 22	•	•	0 - 1.5	No
Kenora	•	•	0 - 1	•	•	0 - 0.5	No
Kingston	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	Yes
Kirkland Lake	•	•	1 - 3.5	•	•	0 - 0.5	No
London	1	0 - 0.5	0 - 1	0 - 0.5	0 - 0.5	0 - 0.5	Yes
Matachewan	0 - 0.5	1	0 - 1	0 - 0.5	0 - 0.5	0 - 0.5	No
Matheson	7.5	1	0 - 1.5	0 - 1	0 - 0.5	0 - 0.5	No
North Bay	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	No
Ottawa	4.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	Yes
Peterborough	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	Yes
Sault Ste. Marie	•	•	0 - 0.5	•	•	0 - 0.5	No
Sudbury	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	No
Thunder Bay	2	1	2 - 3	0.5	0 - 0.5	0 - 0.5	No
Tilbury	14**	0 - 0.5	0 - 0.5	0 - 7	0 - 0.5	0 - 0.5	Yes
Toronto	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	Yes
Windsor	1.5	0 - 0.5	0 - 0.5	0 - 1.5	0 - 0.5	0 - 0.5	Yes

Notes: *Sample not analyzed.
**High solids content did not permit adequate sensitivity. Result reported corresponds to 2 fibres in 20 grid squares examined.

SOURCE: Adapted from: Eric J. Chatfield and M. Jane Dillon, *A National Survey for Asbestos Fibres in Canadian Drinking Water Supplies*, 79-EHD-34 (Ottawa: Health and Welfare Canada, Environmental Health Directorate, 1979), Table 6, p. 31.

per litre.[30] These data were reported in Thunder Bay and led to demands for investigation and for filtration of the city water supply. Independent tests conducted for the Ministry of the Environment showed fibre concentrations of less than 1 million per litre. At a Thunder Bay City Council meeting in April 1975 it was suggested that the high fibre counts produced by Lakehead University might have been the result of laboratory or analytical errors.

Attempting to resolve the controversy, the Ontario Ministry of the Environment established an inter-laboratory study, sending samples of Thunder Bay drinking water to five Ontario laboratories, including the Ontario Research Foundation, McMaster University, the Canada Centre for Inland Waters, Health and Welfare Canada, and Lakehead University. The last two laboratories did not participate in the study. The first three laboratories did analyze the water, yielding results which were described in a report dated September 1975. The average fibre count reported by the Canada Centre for Inland Waters was 0.63 million fibres per litre; McMaster University, 8.45 million; and the Ontario Research Foundation, 0.06 million fibres per litre.[31] Previous studies had shown the Thunder Bay water to contain less than 1 million fibres per litre.[32] The report suggested that the large inter-laboratory differences in reported fibre concentrations might be attributable to differences in counting techniques and differences in the criteria used to identify asbestos fibres. The Ontario Research Foundation, which used relatively sophisticated means for determining whether fibres were asbestos or some other mineral, reported the lowest fibre count. The report concluded by recommending that standards be set for measuring asbestos fibre concentrations in water. The Ontario Research Foundation has subsequently been engaged by the U.S. Environmental Protection Agency to develop a technique to be used for measuring the asbestos in water in the United States.

Asbestos may be deposited in water supplies by natural mechanisms such as the airborne transfer of fibres from wind erosion of asbestiform mineral outcroppings. Cunningham and Pontefract discussed surveys undertaken in British Columbia and the Yukon which linked the levels of asbestos in water to ground water drainage and surface run-off in areas where there was natural exposure of asbestos-bearing bedrock.[33]

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[30] Don Smith, "University Dean of Science Urges Filtering of Water Now," *Chronicle-Journal* (Thunder Bay, Ontario), 18 April 1975, p. 1.

[31] Ontario, Ministry of the Environment, "An Inter-laboratory Study of Asbestiform Mineral Fibre Levels in the Water Supply of Thunder Bay, Ontario," Rexdale, Ontario, September 1975, Table 7, p. 17.

[32] Ibid., Table 9, p. 22.

[33] Cunningham and Pontefract, "Asbestos Fibres in Beverages and Drinking Water," pp. 332-333.

Another possible source of fibre release into water supplies is the asbestos-cement pipe used for water distribution in sewage systems. Asbestos-cement pipes are composed of 85% Portland cement and 15% asbestos. The asbestos component contains both chrysotile and crocidolite fibres in approximately a 4 to 1 ratio.[34] Sometimes amosite is used in place of crocidolite. The amount of fibre release from interior wall deterioration of asbestos-cement pipe has been the subject of much investigation. Olson addressed this issue and concluded that ". . . water flowing through asbestos-cement pipe does not increase the level of fibre content significantly."[35] In contrast, Buelow, Millette, and McFarren have found that asbestos-cement pipe behaves much like other piping materials, except plastic, that are in common use for the distribution of drinking water. If aggressive conditions towards the piping material exist (measured by pH, alkalinity, and hardness), the pipe will corrode and deteriorate.[36]

Mah and Boatman utilized transmission and scanning electron microscopy to study the interaction between water and asbestos-cement pipe. After one month of water flow, bundles of asbestos fibres were observed on the inner surface of pipe which had originally been smooth. Additionally, aggressive water circulated for 218 days in asbestos-cement pipes exhibited an asbestos content of 3.6 million fibres per litre. Prior to the 218-day period, the asbestos content was 1.35 million fibres per litre.[37]

Substitutes with equivalent performance characteristics are available for asbestos-cement pipe for sewage and water distribution applications. However, for pipe diameters of 24 inches and less, the use of substitutes may not be cost competitive.[38]

It appears that the most important source of asbestos deposition in large cities is industrial. High concentrations of asbestos fibres in water supplies near asbestos mining and manufacturing sites may result from the disposal of industrial asbestos-containing waste. The most notable example

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[34] Data from Johns-Manville Canada. See also, Robert A. Clifton, "Asbestos," in *Mineral Facts and Problems*, 1980 ed. (Washington, D.C.: U.S. Department of the Interior, Bureau of Mines, 1981), pp. 1–17.

[35] Harold L. Olson, "Asbestos in Potable-Water Supplies," *Journal American Water Works Association* 66:9 (September 1974): 515–518.

[36] R.W. Buelow, J.R. Millette, and E.F. McFarren, "Field Investigation of the Performance of Asbestos-Cement Pipe Under Various Water Quality Conditions," Cincinnati, Ohio, U.S. Environmental Protection Agency, 1977.

[37] M. Mah and E.S. Boatman, "Scanning and Transmission Electron Microscopy of New and Used Asbestos-Cement Pipe Utilized in the Distribution of Water Supplies," in *Scanning Electron Microscopy/1978/1*, ed. O. Johari (AMF O'Hare, Illinois: SEM Inc., 1978), pp. 85–92.

[38] Richard A. Simonds and James L. Warden, "Substitutes for Asbestos-Cement Pipe," in *Proceedings of the National Workshop on Substitutes for Asbestos*, Arlington, Virginia: 14–16 July 1980, EPA-560/3-80-001 (Washington, D.C.: U.S. Environmental Protection Agency, 1980), p. 160.

arises from the Reserve Mining Company, mining a low grade taconite ore in Babbitt, Minnesota, which is sent to Silver Bay for refining. For every ton of pellets produced, more than 2 tons of silica waste tailings containing cummingtonite are discharged into Lake Superior. Until legal action halted the dumping of the tailings into the lake, the company disposed of 67,000 tons of waste per day. This allegedly caused the concentration of amphibole fibres in Duluth drinking water to rise to between 1 million and 644 million fibres per litre.[39] As well, it was asserted in studies presented during litigation that effluent asbestos particles could move several hundred miles.[40]

We are not aware of asbestos wastes in Ontario being discharged into fresh water lakes in quantities approaching those discharged by Reserve Mining. In any event, we have concluded that the evidence fails to indicate adverse health effects from asbestos fibres in water.

In the United States, the Asbestos Manufacturing Point Source Category Regulations,[41] promulgated under the authority of the *Federal Water Pollution Control Amendment Act* of 1972,[42] limit pollution discharge, including total suspended solids, pH, and chemical oxygen demand, for effluents from various asbestos sources. The Act requires that all industrial sources treat effluents by applying the *best practicable control technology* (BPT) available by July 1, 1977 and the *best available control technology economically achievable* (BAT) by July 1, 1984. The BPT and the BAT are both defined for various asbestos manufacturing concerns. It is not anticipated that these targets will be achieved.

While the U.S. Food and Drug Administration has statutory authority to protect the public from unsafe hazards, no regulations governing levels of asbestos in water have been passed.

In the United Kingdom, the *Water Act, 1973*, requires local authorities to supply "wholesome" water.[43] The Model Water Byelaws, 1966, promulgated under this Act, prohibit allowing materials which can cause contamination to come into contact with water.

In Canada, the federal government has not established standards regulating asbestos-containing effluents. Most provinces have enacted water quality legislation. In most cases, these statutes contain general prohibitions preventing the deposit of substances in water which degrade water quality.

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[39] R.W. Durham and Thomas W.S. Pang, *Asbestos Fibers in Lake Superior*, American Society for Testing and Materials: Special Technical Publications, no. 573 (Philadelphia: ASTM, 1975).

[40] *U.S. v. Reserve Mining*, 380 F. Supp. 11; 6 ERC 1657 at 1669 (1974).

[41] 39 FR 7526, 26 February 1974.

[42] 33 U.S.C.A. § 1251.

[43] 21 Eliz. II, c. 37, s. 11(2).

Effluent discharge into water is, in Ontario, subject to the provisions of the *Ontario Water Resources Act*, which prohibits the deposit of any material which may cause injury to any person, animal, bird, or any living thing.[44] However, regulations promulgated under the Act do not set specific effluent standards for asbestos. The "Ontario Drinking Water Objectives," developed by the Ministry of the Environment, state that it is not possible at present to establish a standard for asbestos levels in drinking water, in view of the lack of epidemiological data.[45]

In view of our conclusions set out at the beginning of this section that the evidence fails to indicate adverse health effects from oral ingestion of asbestos, we do not recommend any change in the Ministry of the Environment's present approach to asbestos in drinking water. The health evidence does not suggest a need for standards for asbestos levels in water at this time.

B.3 Food and Beverages

Asbestos has been widely used as a component of filters employed by the food industry. Cunningham and Pontefract measured the amount of asbestos in filtrate using electron microscope methods and found these levels to be comparable to those in tap water, melted snow, and river water.[46] For the Canadian samples, all the asbestos identified was chrysotile, with a length less than 1 micron. The study found between 1.1 million and 6.6 million asbestos fibres per litre in Canadian and American beer and between 1.7 million and 12.2 million fibres per litre in Canadian soft drinks.

Wehman and Plantholt detected asbestos in commercial gin.[47] Gaudichet et al. studied asbestos fibres in 42 bottles of wine from France and abroad and found statistically significant concentrations of chrysotile asbestos in 15 bottles. Concentrations ranged from 2 million to 60 million fibres per litre with a fibre length of from 0.9 to 3.9 microns.[48]

In June 1977, the Consumers' Association of Canada (CAC) published findings similar to those cited above. According to tests conducted by the CAC, levels of asbestos in excess of 2 million fibres per litre could be

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[44] R.S.O. 1980, c. 361, ss. 14, 15(3), 16(1), and 16(3).

[45] Ontario, Ministry of the Environment, Water Resources Branch, "Ontario Drinking Water Objectives," Toronto, in press, 1983.

[46] Cunningham and Pontefract, "Asbestos Fibres in Beverages and Drinking Water," p. 332.

[47] Henry J. Wehman and Barbara A. Plantholt, "Asbestos Fibrils in Beverages. I. Gin," *Bulletin of Environmental Contamination and Toxicology* 11:3 (March 1974): 267-272.

[48] A. Gaudichet et al., "Asbestos Fibers in Wines: Relation to Filtration Process," *Journal of Toxicology and Environmental Health* 4:5-6 (September-November 1978): 853-860.

detected in foreign wines. The CAC asserted that "The presence of any asbestos in wine is unnecessary and dangerous" and recommended ". . . prohibition of the use of asbestos filters in preparation of any material which would find its way into the human body. . . ."[49]

However, the CAC study and the other beverage surveys cited above did not show that asbestos filters were responsible for the asbestos contamination in beverages and water. In order to identify the filter as a source of fibre emission, it would have been necessary to demonstrate that the asbestos levels found in water used for beverage production were significantly lower than the levels detected in the final product. However, none of the studies above presented such measurements. The Health Protection Branch of Health and Welfare Canada does not consider action restricting the use of asbestos as a filter component to be necessary on the basis that ". . . it does not appear that the use of asbestos component filters results in levels of asbestos fibres in the finished product above natural background levels."[50] We agree with this conclusion.

We note, however, that in Ontario, the Liquor Control Board (LCBO) reacted to the publication of the CAC report by issuing a directive calling for the immediate cessation of the use of asbestos filters by domestic and foreign producers of wines, spirits, and beer.[51]

In its submission to this Commission, A.O. Wilson Process Equipment Limited, a filter manufacturer, charged that the LCBO has enforced the directive in a fashion which imposes severe restrictions on Ontario wine producers while turning a blind eye to violations committed overseas:

> Wine filtration in each and every major wine producing country of the world is, to our knowledge, using the finest filtration material available — "asbestos," and their respective products are being imported into the province of Ontario and sold through our LCBO to the public. But it's a *no no* for Ontario wineries to use this identical material to filter their wines.[52]

Our staff has determined that only a few samples are examined by the LCBO each year, out of millions of bottles sold and hundreds of brands listed. Although foreign manufacturers are informed of the directive, it is

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[49] "Test: Asbestos in Wine," *Canadian Consumer* (June 1977): 44–47.

[50] Sandra Glasbeek, *A Survey of Asbestos Policies in Canada with Particular Emphasis on Ontario*, Royal Commission on Asbestos Background Paper Series, no. 1 (Toronto: Royal Commission on Asbestos, 1981), p. 40.

[51] Ibid.

[52] A.O. Wilson Process Equipment Limited, Written submission to the Royal Commission on Asbestos, #58, 1981, p. 2.

reasonable to assume that without greater diligence in monitoring and enforcement, these overseas manufacturers will enjoy a wide degree of latitude in complying. It therefore appears that the use of asbestos filters by foreign producers continues unimpeded.

Regarding the adequacy of substitute materials, it appears that the filters containing non-asbestos substitutes, such as cellulose and glass, are equal in performance to asbestos filters, save for the removal of "haze" from liquid beverages, an important limitation. These non-asbestos filters, which can be used interchangeably with asbestos filters, are reported to cost 10 to 15% more than asbestos filters.[53]

Other jurisdictions have not imposed comprehensive regulations on asbestos in food and beverages. In the United States, consideration was given to regulating the use of asbestos in talc used as a food or ingestable drug ingredient, but action was deferred until further evidence on the effect of asbestos ingestion was available.

In the United Kingdom, the *Food and Drugs Act, 1955*, provides that no substance may be added to food that would render it "injurious to health."[54] However, with one minor exception, no regulations have been enacted which specifically address the question of asbestos in food. The one exception is in the Miscellaneous Additives in Food Regulation, 1980, which provides that asbestos should not be present in food talc.[55] The U.K. Advisory Committee on Asbestos rejected specific statutory control of asbestos in food, but recommended a review of information concerning the risk to health from the contamination of food and drink by asbestos. The Advisory Committee also reported the recommendation of a Food Additives and Contaminants Committee that attempts should be made to find alternative materials for asbestos filters used in the preparation of food.[56] Apparently, the great majority, if not all, uses of asbestos filters in the preparation of food and drink have now been phased out in the United Kingdom. This was accomplished by industry, with the encouragement of government.[57]

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[53] GCA Corporation, "Asbestos Substitute Performance Analysis," draft revised final report prepared by Nancy Krusell and David Cogley for the U.S. Environmental Protection Agency, GCA-TR-81-32-G (Bedford, Mass.: GCA Corporation, February 1982), pp. 52-63.

[54] 4 Eliz. II, c. 16, s. 1(1).

[55] S.I. 1980/1834.

[56] U.K., Advisory Committee on Asbestos, *Asbestos — Volume 1: Final Report of the Advisory Committee* (Simpson Report), William J. Simpson, Chairman (London: Her Majesty's Stationery Office, 1979), paragraphs 260-263 and Recommendation 39, pp. 92-93; and paragraphs P23-P24, p. 95.

[57] Telephone communication between Mr. Stanley King and Royal Commission on Asbestos Staff, 29 June 1983.

At the federal level in Canada, the *Food and Drug Act* provides that no person shall sell an article of food that has in it a "poisonous or harmful" substance.[58] No regulations have been passed under this Act which would restrict the use of asbestos in the food industry.[59]

In most provinces, provincial public health legislation contains provisions for control over food. Food unfit for human consumption may be prohibited under such legislation. The Ontario *Public Health Act* provides that local authorities may regulate the maintenance of premises where food or beverages are being produced.[60] The Food Premises Regulation under the *Public Health Act* provides that premises where food is handled must be free from any condition that may be "dangerous to health."[61] However, the only Ontario agency to prohibit the use of asbestos in food and beverage preparation is the Liquor Control Board, which, as discussed above, has prohibited the use of asbestos filters by producers of wines, spirits, and beer.

In view of the evidence summarized above on the health effects of ingested asbestos, and in view of the fact that asbestos fibre levels in filtrate do not appear to be significantly higher than levels in drinking water, we see no need for new legislation which would specifically limit levels of asbestos in food and beverages. In the same vein, because there is no evidence that asbestos filtration of wines, spirits, and beer causes health problems or that asbestos filters raise the asbestos concentration in beverages, and because the LCBO ban on asbestos filters is not and cannot be enforced effectively against foreign producers, we recommend that:

11.4 The Ministry of Consumer and Commercial Relations should take steps to repeal the Liquor Control Board of Ontario ban on the use of asbestos filters.

B.4 Drugs

Drugs which are injected directly into the body should be considered as posing potentially different concerns than do materials which are inhaled or ingested. Nicholson, Maggiore, and Selikoff examined samples of parenteral (i.e., injectable) drugs in order to determine if they contained asbestos fibre concentrations greater than those in distilled water used in reconstitution. One-third of the samples from two sets of 17 widely used parenteral drugs were found to have levels of chrysotile in excess of those found in

[58] R.S.C. 1970, c. F-27, s. 4(a).
[59] Food and Drug Regulations, CRC, Vol. VIII, c. 870, p. 5963.
[60] R.S.O. 1980, c. 409, s. 9, pars. 20, 21, 38, 39.
[61] R.R.O. 1980, Reg. 840, s. 12(a)(i).

distilled water. The researchers linked the chrysotile contamination to the use of chrysotile-containing filters in the manufacture of drugs.[62]

Selikoff and Lee have reported on a follow-up study undertaken in 1974 to determine whether contamination was a continuing problem with injectable drugs and whether it occurred in oral drugs. Of the 49 parenteral drugs sampled, 8 were found to have concentrations of asbestos at least 10 times greater than the average background levels in terms of both number and mass of fibres present. None of the oral drugs showed significantly high concentrations of asbestos.[63]

In the United States, a study was undertaken on the carcinogenic effects of intravenous injection of small fibres of chrysotile asbestos into rats and mice. The Research Project Summary concluded as follows:

> The studies have demonstrated that by the intravenous route the administration of fairly large doses of chrysotile asbestos to standard strains of mice and rats on an acute and subacute basis can be tolerated, and have little effect on survival rate. At large doses, up to about 1.6×10^{10} fibers/kg, over a period of 4 weeks, no carcinogenic effects were demonstrated in rats when studied for a lifetime. On the other hand, whereas mice survived well, there was evidence of carcinogenicity that was dose related and time related and possibly sex related. Whereas there were not enough animals on test to demonstrate a "no effect" dose, there is a suggestion that this dose would be fairly high, perhaps as high as 8×10^8 fibers/kg. Of course there is no way of extrapolating such figures from mouse to man, and man frequently has a body burden (lung) from the inhalation route. It would seem prudent to avoid exposure to chrysotile asbestos in parenteral products whenever possible, and this has been done in the FR Final Order dated March 14, 1975.[64]

Comparing the huge doses administered in the U.S. study to the trace asbestos found in filtered drugs leads us to conclude that the risk of cancer caused by the injection of drugs is negligible.

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[62] William J. Nicholson, Carl J. Maggiore, and Irving J. Selikoff, "Asbestos Contamination of Parenteral Drugs," *Science* 177:44 (14 July 1972): 171-173.

[63] Irving J. Selikoff and Douglas H.K. Lee, *Asbestos and Disease* (New York: Academic Press, 1978), pp. 128-130.

[64] U.S., Food and Drug Administration, National Center for Drugs and Biologics, Research Project Summary of FDA 223-77-3017, and prior contracts entitled "Animal Studies of Chrysotile Asbestos by the I.V. Route," prepared by International Research and Development Corporation, Mattawan, Michigan, 18 December 1980, p. 119. See also, 40 FR 11865-11869, 14 March 1975.

The U.S. Final Order of March 14, 1975, referred to above, prohibits the use of asbestos filters in the manufacture, processing, or packaging of parenteral drugs, unless it is not possible to manufacture that drug without the use of such a filter.[65] If use of an asbestos filter is necessary, an additional non-fibre releasing filter must be used unless it is proved that such additional filtration would compromise the safety or effectiveness of the drug.

In Canada, drugs are regulated by the federal government under the *Food and Drug Act*.[66] There is no regulation regarding the presence of asbestos in drugs or the use of asbestos in the manufacture of drugs.

The provinces may regulate asbestos contamination in drugs by virtue of their capacity under the Constitution to protect public health. In some provinces, specific provision is made for regulation of the quality of drugs, either through public health legislation or through legislation governing pharmaceuticals. In Ontario, the *Public Health Act* allows the Ministry of Health to control the sale of impure vaccines and serums.[67] We are not aware of any provincial law directed specifically at asbestos in drugs.

The Health Protection Branch of Health and Welfare Canada has informed the Commission that it is aware of only two applications in which asbestos may be present in the manufacture of drugs in Canada. The Salk vaccine, administered subcutaneously, is filtered with an asbestos filter and is subsequently filtered two more times, first with a nylon filter and then with a Millipore filter. The Sabin vaccine, given orally, is filtered with an asbestos filter and then with a nylon filter. The secondary non-asbestos filters serve to reduce the asbestos content in the drugs. Manufacturers of these drugs are currently attempting safely to eliminate the use of asbestos filters; this may be a few years away.[68]

We see no need for regulatory action to reduce the existing use of asbestos filters in parenteral drugs in Canada.

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[65] 21 CFR Part 133.

[66] R.S.C. 1970, c. F-27.

[67] R.S.O. 1980, c. 409, s. 7(c).

[68] Telephone communication between Dr. John Furesz, Director, Bureau of Biologic Drugs, Health Protection Branch, Health and Welfare Canada and Royal Commission on Asbestos Staff, 16 May 1983.

APPENDIX M-1-C

ASBESTOS RESULTS OF GROUNDWATER SAMPLES
COLLECTED IN SEPTEMBER, 1984
(First Round of Sampling)

Client CANTON ANALYTICAL LABORATORIES

Sample Description BLANK EMS Lab No. 6066

Chrysotile Fibers	0	MFL
>5 Microns Length (Chrysotile)	0	MFL
Mass (Chrysotile)	0	µg/L
More/Less than 5 Chrysotile Fibers in Sample	LESS	
Detection Limit	0.02	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles						

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles						

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles						

Client CANTON ANALYTICAL LABORATORIES

Sample Description 9-939 Well #1 EMS Lab No. 6066

Chrysotile Fibers	1.5×10^4	MFL
>5 Microns Length (Chrysotile)	6.4×10^2	MFL
Mass (Chrysotile)	2.0×10^2	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	1.3×10^2	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	12	36	30	12	8	15

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	2	93	17	1	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	22	38	22	7	7	17

EMS Laboratories

Client CANTON ANALYTICAL LABORATORIES

Sample Description 9-940 Well #2 EMS Lab No. 6066

Chrysotile Fibers	1.5×10^3	MFL
>5 Microns Length (Chrysotile)	72	MFL
Mass (Chrysotile)	25	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	9.0	MFL

1-30

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	29	63	36	11	5	19

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	16	129	15	2	0	1

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	37	64	29	10	8	15

EMS Laboratories

Client CANTON ANALYTICAL LABORATORIES

Sample Description 9-941- Well #3 EMS Lab No. 6066

Chrysotile Fibers	1.7×10^2	MFL
>5 Microns Length (Chrysotile)	2.7	MFL
Mass (Chrysotile)	1.9	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	1.4	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	28	49	21	8	4	15

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	11	109	9	3	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	34	42	23	8	4	14

Client CRNTON ANALYTICAL LABORATORIES

Sample Description 9-942 Well #3 (IRE PLICATE) EMS Lab No. 6066

Chrysotile Fibers	1.5×10^2	MFL
>5 Microns Length (Chrysotile)	12	MFL
Mass (Chrysotile)	3.8	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	1.4	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	8	37	17	19	7	23

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	9	85	12	2	3	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	16	29	23	18	5	20

EMS Laboratories

Client CANTON ANALYTICAL LABORATORIES

Sample Description 9-943 Well #4 EMS Lab No. 6066

Chrysotile Fibers	5.0×10^3	MFL
>5 Microns Length (Chrysotile)	2.5×10^2	MFL
Mass (Chrysotile)	76	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	49	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	9	41	22	4	4	22

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	10	82	7	3	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	14	40	16	5	7	20

EMS Laboratories

Client CANTON ANALYTICAL LABORATORIES

Sample Description 9-944 Well #5 EMS Lab No. 6066

Chrysotile Fibers	3.4×10^3	MFL
>5 Microns Length (Chrysotile)	2.3×10^2	MFL
Mass (Chrysotile)	1.0×10^2	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	29	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	7	29	26	15	11	29

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	9	92	14	2	1	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	17	30	26	12	11	22

EMS Laboratories

Client CANTON ANALYTICAL LABORATORIES

Sample Description 9-945 Field Blank EMS Lab No. 6066

Chrysotile Fibers	0.8	MFL
>5 Microns Length (Chrysotile)	BELOW DETECTION LIMIT	MFL
Mass (Chrysotile)	0.01	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	0.02	MFL

1-35

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	7	15	13	7	1	6

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	5	37	7	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	7	22	10	5	1	4

Laboratories

12563 CRENSHAW BOULEVARD, HAWTHORNE, CALIFORNIA 90250 • (213) 973-6694
211 PASADENA AVENUE, SOUTH PASADENA, CALIFORNIA 91030

DATE: June 18, 1985

CLIENT: Kumar Malhotra & Associates
3000 East Belt Line N.E.
Grand Rapids, Michigan 49505

ATTENTION: Mr. Kumar Malhotra

REFERENCE: Verbal Request
Mr. Malhotra

REPORT NO: 6242

SUBJECT: QC ITEMS FOR WATER SAMPLES

Enclosed are the QC items you requested. The QC procedure calls for a laboratory blank and the analysis of a standard solution made up to 10 MFL chrysotile fibers and a mass of less than 0.1 µg/L.

The results shown on the enclosed analysis of the standard are within acceptable limits.

Respectfully submitted,

EMS LABORATORIES, INC.

A. J. Kolk, Jr.
Technical Director

AJK/keb

Enclosures

Client KUMAR MALHOTRA + ASSOCIATES

Sample Description STANDARD EMS Lab No. 6242

Chrysotile Fibers	12	MFL
>5 Microns Length (Chrysotile)	BELOW DETECTION LIMIT	MFL
Mass (Chrysotile)	0.08	µg/L
More/Less than 5 Chrysotile Fibers in Sample	MORE	
Detection Limit	0.1	MFL

J-37

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	21	65	11	3	3	4

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	15	85	5	1	1	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	30	51	13	5	4	4

Client Kumar Malhotra + Assoc. Inc.

Sample Description Blank EMS Lab No. 6242

Chrysotile Fibers	0.01	MFL
>5 Microns Length (Chrysotile)	Below Detection Limit	MFL
Mass (Chrysotile)	2×10^{-5}	µg/L
More/Less than 5 Chrysotile Fibers in Sample	Less	
Detection Limit	0.01	MFL

SIZE DISTRIBUTION
(Chrysotile Only)

Particle Length - Microns

	0-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	2.5 up
No. of Particles	1	0	0	0	0	0

Particle Width - Microns

	0-0.04	0.05-0.09	0.10-0.14	0.15-0.19	0.20-0.24	0.25 up
No. of Particles	0	1	0	0	0	0

Aspect Ratio L/W

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50 up
No. of Particles	1	0	0	0	0	0

APPENDIX K

ADDITIONAL SITE INVESTIGATIONS

• ENGINEERS • CONSULTANTS • PLANNERS •

KUMAR MALHOTRA & ASSOCIATES INC

3000 East Belt Line N.E.
Grand Rapids, Michigan 49505
Telephone (616) 361-5092

June 24, 1985
(Revised July 3, 1985)

Mr. Rodney Gaither
Project Coordinator (RPM) 5HE-12
USEPA, Region V
230 S Dearborn Street
Chicago, Illinois 60604

Re: Johns-Manville Waukegan Area RI/FS
(Additional site investigations in response to Draft RI Review Comments)

Dear Mr. Gaither,

This letter is to confirm our discussions on the following two tasks which involve additional site investigations. The data obtained through these tasks will be used to prepare responses to some of your review comments (items 3, 5 and 6 on page seven) on the draft RI report. These responses will be summarized in a technical memorandum and submitted for your review.

1. ANALYSIS OF COMMON INORGANIC ANIONS IN THE GROUND WATER.

As indicated by you, the purpose of the anion analysis of the ground water is to correlate if possible the ground water movement directions obtained by using temperature and elevations data with those obtained using major anion levels. Therefore, anions which are normally present in relatively large concentrations will be used to estimate ground water movement directions at the site. We propose to use the following measurements for this purpose.

Chlorides
Sulfates
Total alkalinity including carbonates
Specific conductance
Nitrates Nitrogen

We propose to analyze the ground water and Lake Michigan shore water samples for anions. The second set of samples which were collected on April 29 and 30, 1985 for asbestos analysis (as discussed in June, 1985 technical memorandum No. M-I) will be used for the anion data. If desired a second set of samples will be collectd for repeating the anion analysis.

The results obtained will be used to plot ground water movement directions and compare with those obtained through the use of ground water temperature and elevation data.

2. ON-SITE LEAD CONCENTRATION IN AIR

According to my discussion with you on the details of air sampling and to meet the intent of 40 CFR 50.12 on Ambient Air Lead concentrations, KMA proposes to sample air at nine locations (see attached figures 1 & 2 for on-site and off-site locations) on three different days, each for a period of 24 + hours. Air will be sampled according to the procedure outlined in Appendix G referred to in 40 CFR 50.12. In addition a portable wind vane and anemometer will be used at each location to obtain wind direction and wind velocity. If 0.10 inch of precipitation or more occurred during any test run, then that test run will be repeated after a waiting period of at least 24 hours. Standard high volume air samplers with glass fiber filter will be used. The air volume will be between 39 cfm (1.1 m^3/min) and 60 cfm (1.7 m^3/min).

The air filter will be the standard recommended for total suspended particulate matter (TSP) which has 99% capture efficiency to retain particles of 0.3 μm diameter at 1.5 m^3/min air rate. Air temperature and pressure will also be recorded at each location. The air flow rate for each sampler will be calibrated and recorded in a log book. The wind velocity and direction observations will be made three times during each test run. The sampling filters will be analyzed for lead using the USEPA recommended procedure. Blank filters and duplicates will be analyzed for quality control.

The field activities will be conducted during the week beginning July, 29, 1985 and will be coordinated with you so that you could witness some of the field sampling activities. The study will be summarized in a report. Based on the results of previous personal air sampling and results of remedial investigations, we propose to provide level D site health and safety protection during field activities.

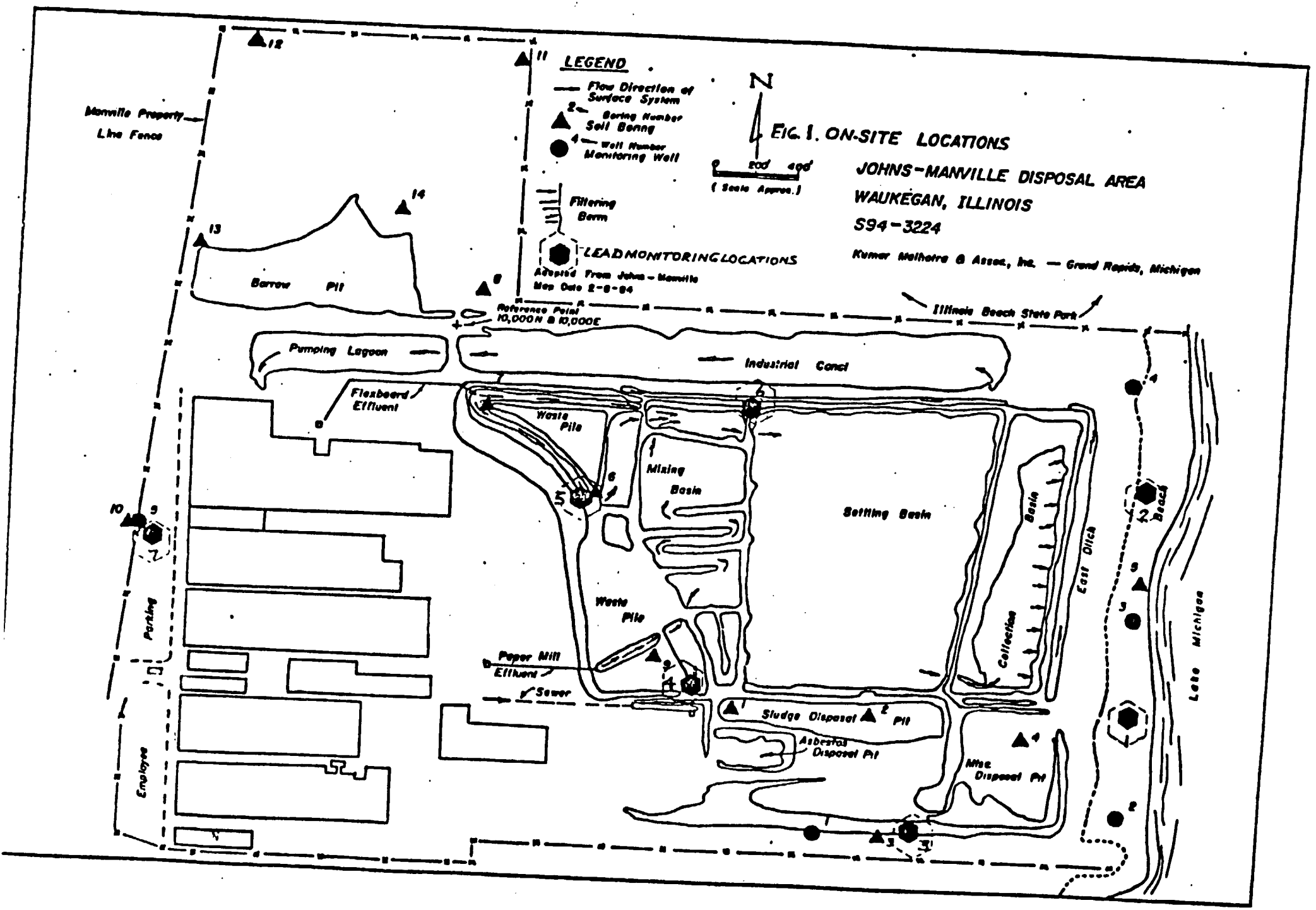
The results obtained from the above two tasks will be submitted in the form of a technical memorandum by the 15th of September, 1985.

Please feel free to contact me if you have any questions on any of the information included in this letter.

Sincerely yours,

S. K. Malhotra, Ph.D., P.E.

cc: Mr. James Whipple, Johns-Manville
SKM:sa


LEGEND
Flow Direction of Surface System
Boring Number Soil Boring
Well Number Monitoring Well
Filtering Berm
LEAD MONITORING LOCATIONS
Adapted From Johns-Manville Map Date 2-8-94
N
200' 400'
(Scale Approx.)
FIG. 1. ON-SITE LOCATIONS
JOHNS-MANVILLE DISPOSAL AREA
WAUKEGAN, ILLINOIS
S94-3224
Kumer Malhotra & Assoc., Inc. — Grand Rapids, Michigan
Manville Property Line Fence
Borrow Pit
Reference Point 10,000N & 10,000E
Illinois Beach State Park
Pumping Lagoon
Industrial Canal
Flexboard Effluent
Waste Pile
Mixing Basin
Settling Basin
Collection Basin
East Ditch
Beach
Lake Michigan
Waste Pile
Paper Mill Effluent
Sewer
Sludge Disposal Pit
Asbestos Disposal Pit
Misc. Disposal Pit
Parking
Employee

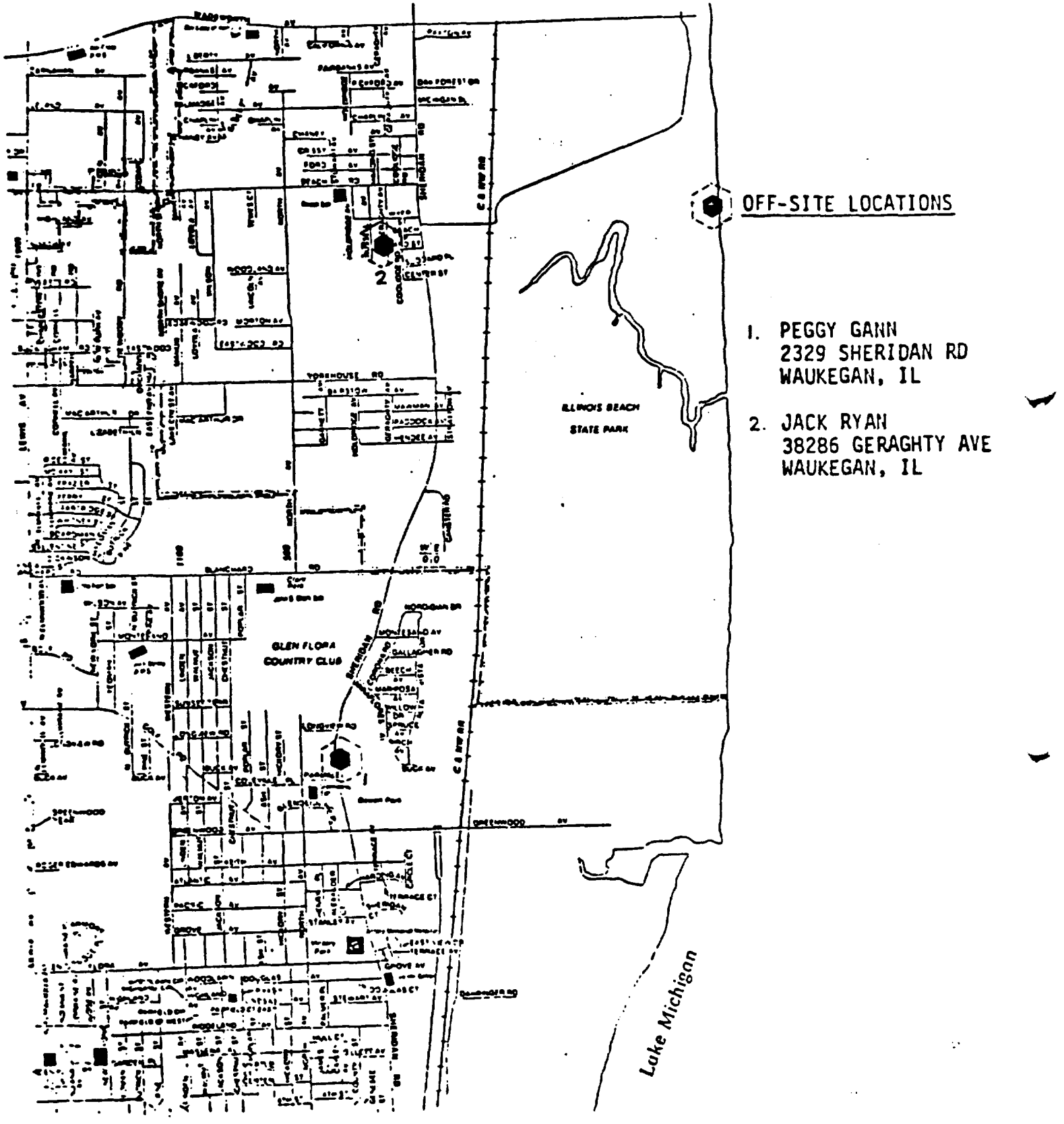


Figure 2 Locations of Off-Site Samplers.